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QUESTIONS FOR THE ACCOUNTING DEPARTMENT

CHEMICAL industry faces a revolution in its bookkeeping methods and philosophy. At a time when operating equipment and methods are being overhauled and modernized to meet present-day conditions, accounting practice in many plants remains the least flexible tool of production — a burden rather than a help in determining true costs and sound replacement policies. Faulty bookkeeping exacts an even more costly penalty in sales administration. Price policies based on inadequate provisions for depreciation, obsolescence and other equally important charges against production point the shortest path to self-destruction. In the light of developments of the past few years, management in chemical industry can well afford to ask some searching questions, such as:

(1). *Do our costing methods adequately account for the losses involved in part-time operations?* Too often accounting practices are still based on capacities and conditions that do not obtain when plants must be operated at 60 or 70 per cent of former peak loads. Despite drastic economies and improved efficiencies all along the line, costs are bound to mount under such conditions. Yet how many managers are giving due consideration to this fact in determining their price policies?

(2). *Is our capital structure in line with present-day working values?* Last June when T. Raymond Pierce advised the chemical executives of M. C. A. to "get going on going values," he pointed to one way out of the difficulties that beset us. Newer plants, better equipped and built more efficiently and at considerably lower costs, can set a terrific pace in the competition for tomorrow's business. The old-timer with a plant paid for at peak prices can compete on an even basis only if he writes down his investment to today's values. If he is saddled with debt and must continue to pay interest on inflated values, he is not going to get very far in the competitive battle of the next few years.

(3). *Do our equipment replacement policies give us the flexibility we need to meet changing conditions in our markets?* The outstanding lesson of this depression has been to demonstrate the fallacy of the old assembly-line scheme of mass production that made it difficult for the manufacturer to change his products and processes. The smaller plant has fared better than the larger one because it has this inherent flexibility in its make-up. It can go into a new field and make money, at the same time writing off its equipment in a half or a third of the conventional period. In the automobile industry today, most of the specialized equipment must pay for itself in a single year; the same is true in other fields in which changing style is the controlling factor. In the chemical industry, where rapid technological advance determines obsolescence, the change is sometimes just as frequent but never as predictable. To continue to use accounting methods that retire equipment only after 10 or 20 years, is merely to postpone the inevitable day of reckoning. Is it not better to face the facts and pay our way as we go?

All of these questions, even though they may seem to conflict in their ramifications, come down to the single one — *Has chemical management the courage to insist on a stronger-price policy?* The answer to that question will determine whether or not the industry can (1) earn an adequate return on a fair investment, (2) provide desirable flexibility in its operations and, (3) pave the way for continued advance as new chemical technology carries it into less competitive and more profitable lines of business.

EDITORIALS

"Get Ready For Prosperity"

PICKING up a twenty-four year old copy of *"The Chemical Engineer,"* our eye was attracted by an advertisement with a strangely familiar message. You will recall that 1908 was a presidential year and when this announcement led off in big type with the words "Now is the time"—we felt sure that it was a plea for the aid of a certain political party. But, no, the reference was to something more important—"Now is the time," it said, "to overhaul your processes and to make them more efficient and economical, thus improve your product and Get Ready for Prosperity!" Just above the enterprising consultant's name and address was the personal plea "Let me do the overhauling."

The American Institute of Chemical Engineers had been founded but a few months before in Philadelphia and presumably its highly ethical code had not yet dampened the enthusiasm of professional advertising. But the interesting commentary is that in the fall of 1908, the country was slowly emerging from a severe depression brought on by the panic of 1907. Then, as now, the way out seemed to be in the modernization of the machinery of production. Apparently the lesson to be learned is that in today's "overhauling" we can afford to be a little more aggressive and self-confident. Chemical engineers have had the experience of having done the job before. We can do it now.

No Chemical Show Until December '33!

DECISION to postpone the Chemical Exposition until December 4-9, 1933, was reached only after several weeks of earnest study and negotiation. Of all the reasons that have been or will be offered for the postponement, the principal one is the too-familiar workings of the depression. Without the assurance of a sufficient audience, some of the exhibitors balked at the expense of exhibiting. Without exhibits, it is obvious that there could be no exposition, so under the circumstances it was only logical that the exhibitors and the management face these facts—if they are facts—and work out a satisfactory solution for their mutual problem.

In the first place all are agreed that the Chemical Exposition is a desirable and constructive agency. It has demonstrated that it can advance the cause of the industry by serving as the marketing place for new developments. It has become an institution that should be profitable both to the producer and the user of machinery and materials.

But this presupposes, first, that there have been developments and, second, that they are of interest to a large and important group of buyers. There can be no doubt that there have been many striking engineering advances since the last exposition. Every manufacturer has made improvements in his product. The only question, therefore, is whether or not the using industries are sufficiently interested in these improvements to warrant the expense of sending their engineers and technical men to see them demonstrated. If they are not sufficiently interested, perhaps the fault is the manufacturer's in having failed to make known the extent of his own developments.

These are times when every urge of self-interest demands improvement in production processes. Lower costs, even with reduced volume of sales, carry with them the compulsion of necessity. Engineers are being forced to get results that were thought impossible a few years ago. The equipment manufacturer is short-sighted indeed if he does not recognize this situation and work with these engineers in the development of their projects.

All of this has only an indirect bearing on the problem at hand. The Chemical Exposition has been postponed in order to build up a greater interest on the part of the using industries and thereby make possible a more productive and profitable show. Accordingly, a heavy responsibility falls on both the temporary committee of exhibitors and on the management of the exposition. Neither can afford to sit back and assume that the Chemical Show is something that generates its own interest. The subject is not one that can be permitted to lie dormant for a year and then be suddenly revived a month or so in advance of the scheduled date. The Chemical Exposition has too important a place and function in our industries to warrant either neglect or exploitation. Those who have its best interest at heart will insist that there should be closer and more effective cooperation and understanding not only between the exhibitors and the management but also between these groups and the much more important audience of engineers and technical men who, in the end, will determine the success or failure of the exposition.

Hardwood, a Raw Material For the Process Industries

PROCESSING of wood usually refers to the soft woods from which paper and pulp are made. Processing of hardwood has had little attention from the chemical engineer. Even the major form of processing, hardwood distillation, has been much neglected by technical men.

Under the joint auspices of the Wood Chemical Institute and *Chem. & Met.*, a survey of this industry has just been completed. A member of our editorial staff traveled over six thousand miles to visit every district of the industry in order to study its economics, its technology, and its business trends. The reports on this investigation appear as a series of staff articles in our pages beginning with this issue.

Shortage of wood supply is often glibly forecast.

With reference to pulp wood in the industrial areas of the northeast such prophecy may be justified. But careless statements often appear to imply that all classes of chemical wood give promise of shortage. Such is not the case. At the present time natural reforestation, supplemented by the most feeble of man's efforts, is restoring to our hardwood forests annually almost as much wood reserve as is being removed by fire, disease, or industrial use. The annual removal is estimated by Federal authorities as less than five per cent of the present stand of commercial sizes. There is no prospect of shortage. The great problem is to get better technologic utilization of this material. We believe that chemical engineers generally should give more thought to hardwood, not only in its present uses, but perhaps also for different, and entirely novel applications.

Avoiding Confused Dryer Terminology

COMPARED with the older engineering sciences, chemical engineering is still in its early youth and it is not surprising that some of its definitions are loosely phrased and loosely regarded. This is particularly the case in drying, as was brought out on October 18 in a paper given before the Metropolitan Section of the Process Committee of the A.S.M.E. Without attempting to detail the departures from strictly accurate thought that sometimes creep into dryer engineering, it will be worth our while to consider one very simple but highly practical example: the specification of moisture content. How may the quantity of moisture present in a material to be dried be made intelligible? Sometimes it is given on a dry basis, sometimes on a wet basis—and again, all too frequently, on no discernible basis at all! Every dryer manufacturer has had the time-wasting experience of being asked to quote on equipment for a product containing "60 per cent moisture," with not a word to enlighten him as to whether this means 60 per cent on the dry basis—or 150 per cent, which is what 60 per cent on the wet basis becomes.

A moment's reflection will show the desirability of using the dry basis for most dryer problems since, when it is used, only one percentage, that of the moisture, changes during the drying. But whether or not it is possible to standardize on a single basis, there is no reason why the one chosen in any case cannot be specified. As a simplification of the usual terminology, the A.S.M.E. paper suggests that "dry-basis moisture content" and "wet-basis moisture content" be adopted as standard, with the added suggestion that eventually these may be further simplified to "d.b. moisture" and "w.b. moisture." These are simple terms, easy to remember, and their use should eliminate a lot of unnecessary misunderstandings. We recommend them to the attention of chemical engineers.

Watch Your Power Pennies

TODAY no possible source of savings can be safely ignored if management is to be firm in its intention of riding out the storm of red ink that has engulfed us. Many parts of the plant may be scenes for obvious improvement, but there is one part, the power house, that is easy to overlook, for power services are usually only a small factor in total operating cost, while their productive facilities are often tucked away in some odd corner, away from the ken of everybody but the power supervisor and perhaps the operating superintendent. And yet, despite its isolation, the power house may be pumping vagrant dollars into the near-by river, or shooting them into the atmosphere. Because its product is inconspicuous is no reason why it should not share in the increasing efficiency that is demanded today of every other part of the plant. Because it could safely be forgotten in 1929 is surely no valid reason why it can be neglected in 1932.

Some few process plants are in the enviable position of having thoroughly modern power and steam generating equipment, but in the vast majority stealthy obsolescence has insinuated its tentacles into the set-up. Our contemporary, *Power,* is authority for the statement that there are savings of no less than 30 to 80 per cent annual return on the investment to be made through power-equipment modernization in many industrial plants. Here is an outlet for idle dollars—and there are some of them even today—that will often pay as handsome return as any investment that can be made. Watching power pennies is a profitable occupation and one that, assuredly, will help the dollars to take care of themselves.

Go to the Polls On November 8

THIS magazine has no interest in partisan politics except as they affect chemical engineers and the process industries. But its editors recognize the need for much greater participation on the part of all of us as individual citizens in the affairs of local, state and federal government. Carbon P. Dubbs takes his job as mayor of Wilmette, Ill. so seriously as to give it a major share of his time in the present emergency. Charles Abbott Newhall in Seattle backs a campaign for science in government and although defeated by a few votes for nomination as State Senator, continues in the fight as precinct committeeman. Another good chemical engineer, Warren F. Bleecker, runs for Governor of Colorado and Hugh K. Moore has had several exciting if not always successful political tussles in New Hampshire. But these are the few among the many. The least we can do—not as chemical engineers, but as good citizens—is to go to the polls and vote intelligently and constructively on the men and the issues before us.

HARDWOOD DISTILLATION Faces New Economic and

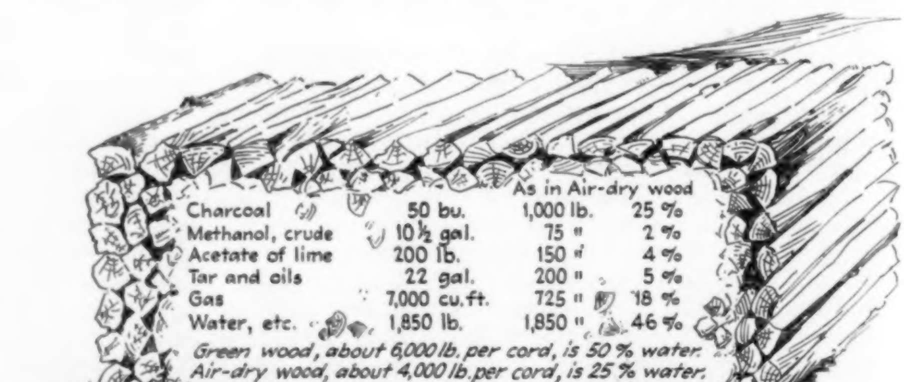
Hardwood distillation creates both problems and products of wide interest to chemical industry. The interrelation of this business with many other divisions of process industry gives far wider significance to the economic problems and the technology than would be indicated by the number of plants or the quantity of products involved. A complete survey of this situation has been made by the author working under the joint auspices of *Chem. & Met.* and the Wood Chemical Institute, Inc. The results of the inquiry, which has necessitated over 6,000 miles of travel to visit every important district, are presented in this and succeeding articles.

TO UNDERSTAND the wood-chemicals business one should have first an understanding of the affiliations which these companies have with other types of industry. Some plants are essentially a part of the charcoal-iron business; others are closely affiliated with the lumbering industry; some are a part of other chemical establishments; and others are really merchant plants operating independent of other activities in a multi-product chemical business.

The trends in different parts of the industry naturally vary with the character of the affiliations as well as with general business conditions. For example, when charcoal iron is in large demand, the wood-distillation plants affiliated must operate at full capacity even though the market for wood chemicals may be slack. But, on the contrary, as at the present time, some of the plants having well established household charcoal markets may be operating on a substantial scale while others find their outlet for charcoal in other fields so curtailed that partial or complete shutdown is necessary. In other words, the wood distillation industry, small though it is, is not a unit. It is a group of still smaller divisions of industry dependent upon factors almost wholly without itself for the determination of its trends and its degree of current activity.

Wood processing plants always go to the source of their raw material. This is an inevitable consequence of the bulky character of wood and the high cost involved in moving it any considerable distance. Therefore, we find hardwood distillation plants only in those limited areas of the United States where an abundance of hardwood can be had at low cost.

In northern Michigan and nearby Wisconsin are found 10 plants which jointly have about 40 per cent of the total capacity of the industry in the United States. In Tennessee, Arkansas, West Virginia, and Kentucky are 7 plants, which as a group provide approximately 20 per cent of the country's productive capacity. The remaining 40 per cent of the industry, in the "Eastern District," is made up by a much larger number of plants (about 30) of which practically all are of small size. These plants are in two groups, one group centering about Bradford, Pa., in the northwestern part of that state and including one operating unit just across the state boundary near Olean, N. Y. The second or Catskill division centers near Hancock, N. Y., but includes one



		As in Air-dry wood	
Charcoal	50 bu.	1,000 lb.	25 %
Methanol, crude	10½ gal.	75 "	2 %
Acetate of lime	200 lb.	150 "	4 %
Tar and oils	22 gal.	200 "	5 %
Gas	7,000 cu.ft.	725 "	18 %
Water, etc.	1,850 lb.	1,850 "	46 %

Green wood, about 6,000 lb. per cord, is 50 % water.
Air-dry wood, about 4,000 lb. per cord, is 25 % water.

Typical yields of wood chemicals from an average cord of hardwood.

The figures given here closely approximate the commercial yields obtained by the better wood chemical plants from good quality of hardwood. Attention is called, however, to the variable practice of the industry in reporting yields on the basis of different moisture contents than those shown here. It will be noted, too, that acetate of lime is not a direct product from the wood so that the added lime will slightly alter the total weights and percentages.

Raw Material Problems

By R. S. McBRIDE

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Washington, D. C.

Hardwood Removed From Forests Annual Quantities for U. S. Estimated in 1932 by Forest Service

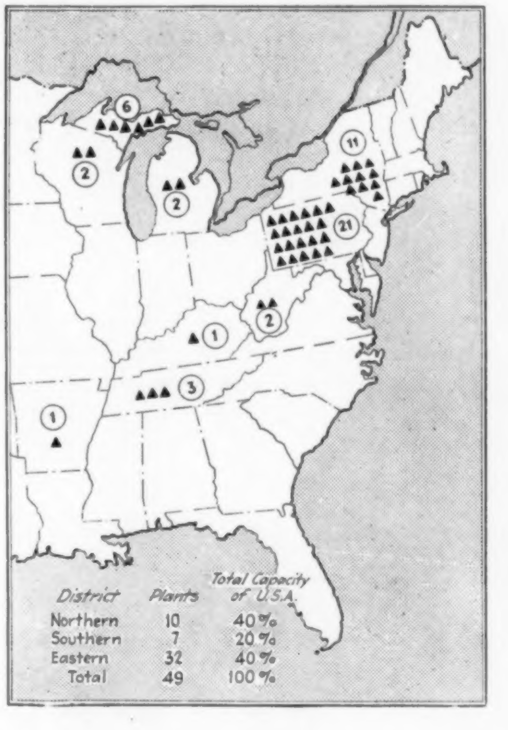
Used to make	(millions)		Cut From: Saw timber (million board feet)	Cut From: Cord wood (thousand cords)	Total (million cu ft.)
Lumber	7,042	board feet	7,042	.....	1,703
Veneer logs	626	board feet	700	.....	171
Logs and bolts in mfrs	501	board feet	568	.....	136
Export logs and timbers	18	board feet	20	.....	5
Fuel wood	39	cords	2,900	20,433	2,518
Pulpwood	0.6	cords	157	257	67
Distillation wood	0.85	cords	78	182	32
Tanning extract	0.42	cords	119	38	26
Excelsior	0.12	cords	45	30	14
Hewed ties	31	pieces	1,190	.....	400
Fence posts	257	pieces	645	2,025	350
Poles	0.65	pieces	18	12	6
Piling	0.45	pieces	33	1	8
Mine Timbers	147	cu. ft.	112	1,367	184
Staves	776	pieces	544	.....	133
Heading	41	sets	200	.....	48
Hoops	139	pieces	42	.....	10
Total for commodity use			14,413	24,345	5,811
Fire loss, not utilized			139	2,672	269
Disease, insect, drought, wind, etc., and not utilized			327	2,339	288
Total removed from forest			14,879	29,356	6,368

large isolated plant (at present inactive) above Utica.

The character of the industry is markedly different in the three districts. In the Pennsylvania and New York territory the small plants, individually owned, independently operated, and many using old-style equipment, continue largely because of strictly local economic considerations. Located as they are, each plant is an important unit in its immediate small town and the opportunity for continued operation is surprisingly good. These small plants are often highly seasonal in their operations, workmen being farmers, woodsmen, fishermen, or sometimes of necessity merely idle, when the chemical works do not run. In some cases it is obvious that these plants involve no remaining investment that has not been many times "written off"—if one can assume that the almost entire lack of bookkeeping would involve any such thing as a capital account on its books.

In some instances, these little local enterprises have strange affiliates. One of them visited has as its major spare-time activity the supplying of ferns from a large refrigerated store room of strictly modern type to urban florist customers in cities as much as 200 miles or more distant. Apparently, when wood distillation is not practiced, fern picking or fern shipping takes its place. Obviously no simple set of books or normal chemical cost-keeping would show the opportunity or prospects of such an enterprise. However, a few larger and wholly business-like companies are found in this district.

Where the 49 plants of the hardwood distillation industry are located



Present Stand of Hardwood by Species

	On cordwood areas (million cords)	On saw timber areas (billion board feet)
Oak	232	61
Birch, beech and maple:	127	50
Red gum	25	16
Yellow poplar	19	5
Cottonwood and aspen	14	4
Tupelo	7	6
Others, eastern	127	37
Total eastern hardwood	551	179
Eastern softwood	341	175
Western hardwood	1	3
Western softwood	209	1,311
All species	1,102	1,668

Present stand of hardwood, by size:	
Saw timber	30,472 million cubicf eet
Tops and limbs of saw timber	10,309 million cubic feet
Small trees — cordwood size	27,840 million cubic feet
Stumps, log butts, breakage	2,164 million cubic feet
Cordwood and restocking areas	57,709 million cubic feet
	128,494 million cubic feet

Present annual growth in U. S. on saw-timber and cordwood areas combined:	
Saw-timber size	3,540 million board feet
Total saw and cord size	3,215 million cubic feet
Potential, below size to cut	1,610 million cubic feet

In striking contrast with most of the New York-Pennsylvania area are conditions in Michigan. There the

major reasons for activity have been charcoal-iron making and lumbering-waste utilization. Four of the five United States plants making charcoal iron secure their charcoal fuel here. All but one of the remaining Michigan enterprises are closely affiliated with lumbering activities, taking either waste wood from the sawmill or that wood from the forests which is too small to cut as saw logs but too valuable to leave in the woods as waste. The one exception mentioned is the plant affiliated with the Ford Motor Co. That enterprise, near Iron Moun-

A Survey of the Hardwood Distillation Plants in the United States in 1932

[List compiled by *Chem. & Met.* in cooperation with Wood Chemical Institute, Inc.]

The major operating object is indicated by code letters: *C* production of chemicals; *F* utilization of owned forests where lumbering or saw-log cutting is a minor consideration; *L* utilization of lumbering waste or wood cut in owned forests as a result of simultaneous saw-log lumbering; *M* merchant plant; *W.W.* waste wood utilization. The distinction between *F* and *L* depends largely upon the major objective of forest utilization as practiced by the company in question.

Plant capacity is defined in terms of total cords charged daily, regardless of the quantity incompletely carbonized which must be returned for later recarbonization.

Charcoal is defined as "used" by such companies as normally utilize the bulk of their production in affiliated works; such companies often sell surplus production, especially when the major using enterprise, a charcoal furnace, is shut down.

Company and Plant Location	Plant Capacity (Cords per Day)	Retorts No.	Retorts Type	Retorts Capacity (Cords)	Major Operating Object	Affiliation	Normally Charcoal Sold or Used	Tar Products Made	Acetate or Acetic Acid Made	Methanol Made	Remarks
NORTHERN DISTRICT											
Antrim Iron Co. Mancelona, Mich.	166	18	Thru	9–10	I	Iron furnace	Used	Yes	Acetate	All kinds	Small sawmill in connection
Thos. Berry Chem. Co. Manistique, Mich.	60	6	Thru	10	M	Independent	Sold	....	Acetate	Crude	Refinery recently burned down
Cadillac-Soo Lumber Co. Sault Ste. Marie, Mich.	112	12	Thru	9–10	L	Local lumbering	Sold	No	Acetate	Crude	....
Cleveland-Cliffs Iron Co. Marquette, Mich.	200	20	Thru	10	I	Iron furnace	Used	Yes	Acetic acid from acetate	All kinds	Large sawmill in connection
Cummer-Diggins Co. Cadillac, Mich.	32	4	Thru	8	L	Lumbering	Sold	No	Acetate	Crude	May not reopen, local wood exhausted
Delta Chemical Co. Wells (Escanaba), Mich.	164	18	Thru	9	I	Iron furnace	Used	Yes	Acetate and Acid by ether process	All kinds	....
Ford Motor Co. Iron Mountain, Mich.	270	3 2	Stafford Seaman	110* 25	W.W	Motor Mfr.	Sold as briquets	Yes	Ethyl acetate	C.P.	Treats variety of waste hardwood
Newberry Chem. & Lumber Co. Newberry, Mich.	160	16	Thru	10	I	Iron furnace and lumber	Used	Yes	Acetate	Denaturing and 95-97%	....
Cliffs Chemical Co. Goodman, Wis.	45	5	Thru	9	M	Clev. Cliffs Iron Co.	Sold	No	Acetate	Crude	....
Hackley-Phelps-Bonnell Co. Phelps, Wis.	48	6	Thru	8	L	Lumber company	Sold	No	Acetate	Crude	Future operation questionable
PENNSYLVANIA DISTRICT											
Barclay Chemical Co. Laquin, Pa.	72	9	Thru	8	M	Independent	.....	....	Acetic acid	Refined	Idle for some time
Bradford Wood Products Co. Marvindale, Pa.	24	4	....	6	M	Independent	Sold	No	Acetate	Crude	....
Clawson Chemical Co. Halton, Pa.	60	6	Thru	10	M	Independent	Sold	No	Acetate	Crude	....
Clawson Chemical Co. Gilson (Ridgeway), Pa.	54	6	Thru	9	M	Independent	Sold	No	Acetate	Crude	....
Custer City Chemical Co. Custer City, Pa.	45	5	Thru	9	M	Independent	Sold	No	Acetate	Crude	....
Genesee Chemical Co. Genesee, Pa.	30	5	....	6	M	Independent	Sold	No	Acetate	Crude	....
Gray Chemical Co. Roulette, Pa.	60	10	Stop end	6	F.L.	Independent	Sold	Sell tar	Acetate	Crude	Tar products made by Hardwood Chemical Co.
Heinemann Chemical Co. Crosby, Pa.	68	10	Thru	6½	M	Independent	Sold	No	Acetate	Crude	....
James Manufacturing Co. Kane, Pa.	24	2	Seaman	12	M	Independent	Sold	No	Acetate	Crude	....
Kinzua Valley Chemical Co. Morrison, Pa.	40	4	Thru	10	M	Independent	Sold	No	Acetate	Crude	....
Lewis Run Mfg. Co. Lewis Run, Pa.	32	4	....	8	M	Independent	Sold	No	Acetate	Crude	....
Liberty Wood Products Co. Liberty, Pa.	20	2	Thru	10	M	Independent	.....	....	....	....	Idle for some time
Oswayo Chemical Co. Coneville, Pa.	24	32	Round	½	M	Independent	Sold	No	Acetate	Crude	....
Otto Chemical Co. Sargeant, Pa.	20	2	Thru	10	M	Independent	Sold	No	Acetate	Crude	....
Penn Charcoal & Chemical Co. Smethport, Pa.	28	4	Stop end	7	M	Independent	Sold	No	Acetate	Crude	....
Pa. Wood Products Corp. Coryville, Pa.	30	5	Stop end	6	M	Independent	Sold	No	Acetate	Crude	....
Tionesta Valley Chem. Co. Mayburg, Pa.	104	12	Thru	8–10	M	Lumber company	Sold	No	Acetic acid by ether process	Crude	....
Union Charcoal Co. of Pa. Westline, Pa.	60	6	Thru	10	M	One of group	Sold	No	Acetate	Crude	....
Vandalia Chemical Co Vandalia, N. Y.	40	4	Thru	10	M	Was one of group	.....	....	....	....	Idle for some time
Weyman Chemical Co. Port Allegany, Pa.	24	4	Stop end	6	M	Independent	Sold	No	Acetate	Crude	....
Tioga Wood Products Co. Morris, Pa.	48	6	Thru	8	M	Independent	.....	....	....	....	Idle for some time

*Only 2 Stafford units operated at one time; the third is a spare.

tain, treats the hardwood waste of the Ford enterprises in the only Stafford-process plant of the United States. Thus it forms one of the outstanding units in Mr. Ford's widely, recognized scheme for reclamation or utilization of every item of goods handled. It is a highly technical wood-scavenging operation of distinctive type having peculiar interest for the chemical engineer. More will be said of its economics and its technology in a later article of this series.

The active plants of the Southern district represent five distinct types of business enterprise. One has close chemical affiliations, the Tennessee-Eastman plant at Kingsport. One makes charcoal for an iron furnace, the Tennessee Products Co. plant at Lyles-Wrigley, near Nashville, Tenn. The third Tennessee enterprise is a distinctly merchant plant without specialized industrial affiliations. The Arkansas plant described recently in the pages of *Chem. & Met.* (July, 1932, pp. 382ff.) by its engineer-designer, T. C. Albin, is a lumbering affiliate. It has been established to take the hardwood logs below saw sizes; it is to have later a paper and pulp affiliate which will take softwood from forest operations, thus insuring substantially complete processing of an entire forest area as it is cut over, hardwood lumber, hardwood chemicals, and softwood pulp and paper being the companion products of the Crossett-Watzek-Gates enterprise. The fifth type of active plant in the South is best represented by the merchant enterprise at Kragon, Ky.; its activities, though affiliated with lumber, are primarily intended to give geographic spread to the charcoal marketing of its owner, the Union Charcoal Co., which has its major business in Pennsylvania and New York.

The hardwoods used for distillation are principally maple, beech and birch. In the South, oak, hickory, cherry, tupelo and a number of other less important species contribute to the supply. The major requirement is for wood of the highest bulk density in order that a maximum capacity of the ovens may be maintained. And for this reason small or crooked wood and that which is partially rotted is rejected. In many cases the wood supply is cut in cord size especially for the distillation plant, pieces larger than 6 in. in diameter being split to permit carbonization within the 24-hour cycle without use of excessive temperature. In other cases, slabs, edgings, and even block from affiliated sawmills furnish the raw material. In the case of the Stafford process plant of the Ford Motor Co., wood chips are used; in this case the product is, of course, fine charcoal, which requires briquetting for the market.

A very large part of the hardwood distillation industry secures its wood supply either from owned forests or from the operation of sawmills or logging enterprises of affiliates. In a few cases the cutting of mine timber or other special hardwood supplies is an affiliated activity of importance. In many instances, the major objective of the industry at the present appears to be to secure market for its hardwood forests, which otherwise re-

CATSKILL DISTRICT

Company and Plant Location	Plant Capacity (Cords per Day)	Retorts — No.	Retorts — Type	Retorts — Capacity (Cords)	Major Operating Object	Affiliation	Normally Charcoal Sold or Used	Tar Products Made	Acetate or Acetic Acid Made	Methanol Made	Remarks
Corbett & Stuart Corbett, N. Y.	80	8	Thru	10	M	Independent	Sold	No	Acetate	Crude	....
Thos. Keery Co. Cadosia, N. Y.	60	6	Thru	10	F	Independent	Sold	Sell tar	Acetate and methyl acetate	All grades	Includes refinery and chemical plant
Thos. Keery Co. Roscoe, N. Y	40	4	Thru	10	F	Independent	Sold	Sell tar	Acetate	Crude	....
Keystone Wood Chemical Co. Glenfield, N. Y.	220	22	Thru	10	L	Was one of group	.....	Sold tar	Acetic acid	Refined	Never regularly operated; group broken by receivership
Long Eddy Co., Inc. Walton, N. Y.	18	2	Thru	9	M	Independent	Sold	No	Acetate	Crude	....
Maryland Wood Products Co. Maryland, N. Y.	24	32	Round	$\frac{3}{4}$	M	Independent	Sold	No	Acetate	Crude	....
Miner Edgar Chem. Corp. Rock Rift, N. Y.	40	5	Thru	8	M	Independent	Sold	No	Acetate	Crude	....
C. W. Peak, Peakville, N. Y.	18	24	Round	$\frac{3}{4}$	M	Independent	Sold	No	Acetate	Crude	....
Riefler & Sons, Inc. Honesdale, Pa.	36	6	Stop end	6	M	Independent	.....	....	....	....	Idle for some time
G. H. Treyz & Co. Livingston Manor, N. Y.	18	24	Round	$\frac{3}{4}$	M	Independent	Sold	No	Acetate	Crude	....
George I. Treyz Cooks Falls, N. Y.	36	6	Stop end		M	Independent	Sold	No	Acetate	Crude	....

SOUTHERN DISTRICT

Company and Plant Location	Plant Capacity (Cords per Day)	Retorts — No.	Retorts — Type	Retorts — Capacity (Cords)	Major Operating Object	Affiliation	Normally Charcoal Sold or Used	Tar Products Made	Acetate or Acetic Acid Made	Methanol Made	Remarks
Forest Products Chem. Co. Memphis, Tenn.	80	10	Thru	8	M	Independent	Sold	Yes	Acid by Suida process	Denaturing and 95-97%	Unusual effort on charcoa market
Tenn.-Eastman Corp. Kingsport, Tenn.	140	14	Thru	10	C	Eastman Kodak Co. incl. rayon works	Sold	Yes	Acetic anhydride	Pure and by-products	Chemicals used by affiliated rayon and film companies
Tennessee Products Corp. Lyles-Wrigley, Tenn.	200	22	Thru	9–10	I	Iron furnace	Used	Yes	Acetate and acid by modified Melle process	Denaturing and 95-97%	Part of large metallurgical enterprise
Crossett Chem. Co. Crossett, Ark.	80	8	Thru	10	L	Crossett-Watzek-Gates, lumber and pulp	Sold	Yes	Acid by Suida process	Crude	Management affiliation with Forest Products Chem. Co
Union Charcoal & Chem. Co. Kragon, Ky.	36	4	Thru	9	M	N.Y. and Pa. Companies	Sold	No	Acetate	Crude	....
Buckhannon Chem. Co. Buckhannon, W. Va.	72	8	Thru	9	M	Independent	Sold	No	Acetate	Crude	....
Sutton Chemical Co. Sutton, W. Va.	72	8	Thru	9	M	Miner-Edgar Chem. Corp.	Sold	No	Acetate	Crude	....

main financially unproductive and a loss to the industry.

From the standpoint of the present industry, there is more than an abundance of hardwood supply. Numerous plant operators control two or more times enough forest land to supply their present plants at maximum operating capacity for the indefinite future. The others, with few exceptions, find equally ample reserves near by in the ownership of others. It is evident, therefore, that no artificial reforestation of hardwoods needs be undertaken by the wood distillation industry. Proper cutting methods and adequate fire protection are practiced. Natural reforestation, then, more than maintains the wood reserves. Travel through areas from which wood has been taken for more than a half century of distillation, supplemented by such wood practice, gives clear evidence that no forest denuding results.

The cost of wood delivered at the distillation plant today reflects these conditions. Formerly, a cord of first-class hardwood cost $5 or $6 delivered. Today a number of plants have reduced their payment for wood by steps to as low as $2 per cord, and even then have had to refuse to take offerings in order to prevent building up of stocks beyond the desired amount. The average cost of wood in the plant yard today is probably $3.50 to $4 a cord. This includes stumpage allowance, cutting, hauling in the woods, trucking or rail to the plant and stacking in the wood yard. To this total must be added a reasonable percentage for interest, insurance, and taxes on the wood stored for drying. The period of drying varies from 8 to 18 months, averaging about one year. Hence, with reasonable percentage allowance for the capital charges incurred during this storage period, one need allow only about 40 to 50 cents per cord to gain the total cost of air-dried wood ready to carbonize.

Charcoal Sets the Pace

Regardless of its major affiliation, the major problem of each wood distillation plant today is the prompt marketing of its products, especially the charcoal. When a cord of hardwood is processed, it results in approximately 50 bu. of charcoal. This represents a half ton of very bulky product which must be stored under cover in storage facilities relatively costly per unit of product value involved. It is evident therefore, that a hardwood distillation plant will not continue long in operation if its charcoal is not being promptly sold or shipped to the consuming market. Very few plants have storage for more than a few weeks' production, so that the average plant must be shut down or operated below capacity when the charcoal market is poor.

This situation with respect to charcoal disposal is even more important for the five plants which have their major charcoal outlet at the affiliated charcoal-iron furnaces. When such furnaces shut down, because of lack of market or for other reasons, the wood distillation plant usually must also become idle. And, similarly, in the case of lumbering affiliates, if the sawmill closes or if wood supply is otherwise interrupted, the consequences may be a corresponding interruption of the wood distillation activities.

To a lesser extent the degree of activity in the industry is determined by the market of the two major chemical products, methanol and acetic acid or calcium acetate. These chemical products can, however, be stored either by the producer or by the customer-user in relatively larger quantities. Hence, in few cases does the chemical market determine the rate of operating activity; almost invariably it is the charcoal demand and price which fixes the operating policies. In this respect, the wood distillation is much like coal distillation. There, the coke demand and coke market, both that coke used for the iron blast furnace and the coke used elsewhere for industrial or household fuel, fix operating policies quite independent of the market demand for ammonium sulphate, light oil, or often even regardless of the gas requirements of the company or its customers.

In the case of hardwood distillation, gas is never marketed. It is either used by the producer in his own plant or wasted. Generally it is fully used, though often not efficiently. The vast majority of these plants also use as fuel their entire tar production. Only a few refine the tar to make marketable products and a still smaller number market the tar to others who are tar refiners. It is evident, therefore, that the products, in bulk, weight, or economic importance, in the order of influence on operating practices, are charcoal, calcium acetate (or acetic acid), methanol, tar, and gas.

In the next article of this series, the technology of manufacture and the handling and preparation for marketing of each of these products will be considered. In the third article will be presented a study of the marketing practice and prospects for each of the products sold.

Salient Statistics of the Hardwood Distillation Industry of United States

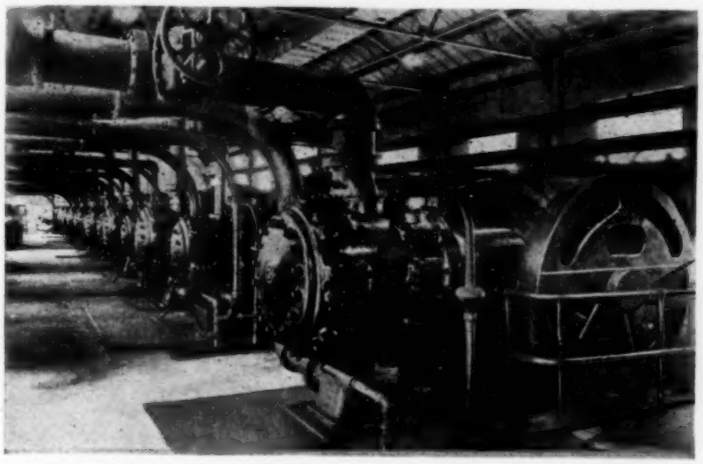
(Data From the Census of Manufactures)

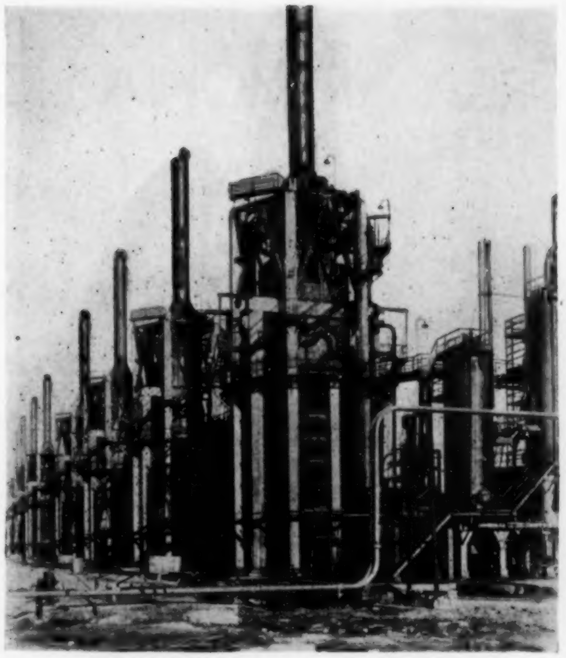
	1909	1914	1919	1921	1923	1925	1927	1929	1931
Establishments active	116*	82*	87	72	76	67	57	53	42
Capacity (cords per day)	3,700*	3,400	4,614	2,283	3,934	3,841	3,540	3,166	3,000*
Wage earners (average)	2,200*	2,300*	3,500*	1,521	2,933	2,866	2,898	2,838	1,800*
Wood used (cords)	1,150,000	970,000	1,186,000	433,000	1,030,000	911,000	822,000	812,000	440,000*
Value of products sold	$9,500,000*	$9,400,000*	$27,000,000*	$8,278,000	$24,262,000	$16,871,000	$17,414,000	$19,478,000	$7,400,000*
Charcoal (and used)	2,300,000	2,700,000	7,700,000*	3,800,000*	7,900,000*	5,294,000	5,691,000	4,923,000	3,500,000*
Crude methanol	1,774,000	1,606,000	5,594,000	1,111,000	4,108,000	2,026,000	2,072,000	1,794,000	383,000
Refined methanol	3,097,000	2,710,000	8,381,000	1,924,000	4,819,000	3,390,000	2,952,000	3,907,000	851,000
Methyl acetone	....	....	134,000	59,000	879,000	458,000	353,000	575,000	233,000
Other chemicals	....	....	1,943,000	351,000	1,221,000	1,355,000	1,432,000	3,841,000	1,129,000
Acetate of lime	2,118,000	2,138,000	2,682,000	737,000	4,763,000	3,437,000	4,021,000	4,695,000	973,000
Tar	113,000	146,000	481,000	198,000	461,000	840,000	798,000	879,000	225,000
Principal Products:									
Charcoal (bu.)	38,000,000	43,000,000	47,000,000*	19,200,000*	43,000,000*	40,400,000	39,200,000	40,800,000	22,000,000
Crude methanol (gal.)	9,300,000	9,600,000	9,100,000	3,950,000	9,125,000	8,650,000	8,000,000	8,350,000	4,140,000
Refined methanol (gal.)	6,730,000	6,240,000	7,000,000	2,715,000	5,040,000	5,870,000	5,000,000	6,675,000	2,750,000
Methyl acetone (lbs.)	....	....	930,000	590,000	6,370,000	3,650,000	2,600,000	4,675,000	3,615,000
Acetate of lime (tons)	71,000*	83,050	84,475	30,650	81,800	81,700	78,150	65,000	35,000
Tar (gal.)	....	2,950,000	2,675,000	1,700,000	5,500,000	8,900,000	8,450,000	10,500,000	5,500,000
Tar sold (gal.)	1,570,000	1,475,000	2,150,000	1,450,000	3,150,000	5,500,000	4,600,000	6,900,000	1,890,000

* Partly estimated by *Chem. & Met.*

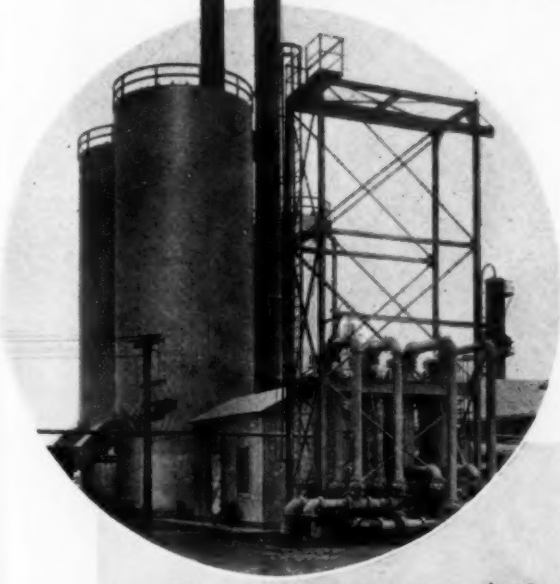
MODERNIZING
America's Largest
PETROLEUM REFINERY

Two-stage, direct gas-engine driven compressors in one of the gasoline recovery plants





Battery of Buerger cracking stills each equipped with deFlorez up-fired furnace and fired with Peabody combination oil and gas burners



Koppers gas purification unit where refinery gases are freed of hydrogen sulphide

A RECENT and extensive construction program has provided the Port Arthur, Texas, plant of the Gulf Refining Co. with thoroughly modern equipment which includes the two largest atmospheric-vacuum stills ever built and new dewaxing plants which operate 92 Sharples super-centrifuges. Buerger and other cracking units having a total daily charging capacity of 54,000 bbl. are all equipped with deFlorez furnaces. Three gasoline recovery plants can process 43,000,000 cu.ft. of refinery gases daily. Two Koppers purification units remove an average of 14 tons of hydrogen sulphide from about 9,000,000 cu.ft. of gas which is treated each day for sulphur removal. More than 2,000 tanks now provide storage for 11,009,890 bbl. of crude oil and finished products.

Gulf Refining Co. plant at Port Arthur, Texas, has a rated crude oil charging capacity of 125,000 bbl. per day

UREA-AMMONIA LIQUOR—

A New Fertilizer Material

By F. W. PARKER and F. G. KEENEN

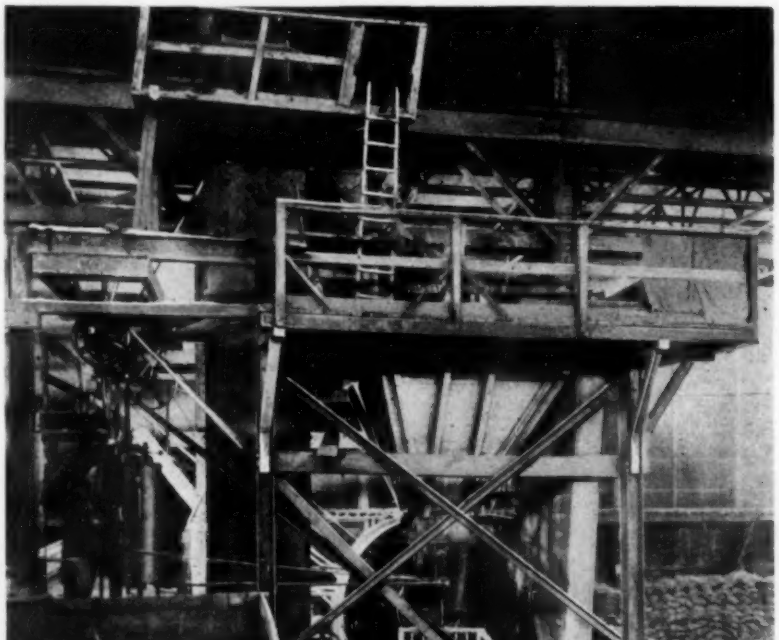
Chemical Division, Ammonia Department
E. I. du Pont de Nemours & Company, Inc.
Wilmington, Del.

TANK CARS suitable for handling anhydrous ammonia were developed in 1926 by du Pont in co-operation with the Bureau of Explosives and made possible greatly lowered prices for ammonia with consequent use of anhydrous ammonia by the fertilizer industry. The rapid and general acceptance of this practice was due in part to the low handling cost per unit of nitrogen, and to the excellent "conditioning" properties of ammonia. Furthermore, the use of uncombined ammonia reduced caking in storage and put the fertilizers in the excellent physical condition so essential for efficient application to the soil under actual field conditions.

Following this advance in fertilizer manufacture, the Ammonia Department of E. I. du Pont de Nemours & Co. Inc. has recently developed a product known as urea-ammonia liquor. During the past year, experimental tank cars of the liquor have been used in a number of fertilizer plants, and in these factory-scale tests, varying quantities of the liquor have been employed with excellent results in the manufacture of many kinds of fertilizer.

Urea-ammonia liquor is essentially a solution of crude urea dissolved in aqua ammonia. Its specific gravity is approximately that of water, and the total ammonia content is 55 per cent. Two-thirds of the ammonia is inorganic, mostly uncombined or free ammonia as in ordinary aqua ammonia. One-third of the ammonia is present as urea, an organic compound that is one of the most important fertilizer constituents in farm manure. Therefore, the liquor is a source of both inorganic and organic nitrogen, and these are in the ratio in which they are found in many complete fertilizers. The water content is only 20 per cent, which is sufficient to lower the crystallization temperature to 5 deg. F. and to lower materially the vapor pressure of the liquor. The water content, however, is so low that the liquor does not cause the fertilizer to stick to the walls of the mixer, nor does the added water limit the amount of liquor that may be used, as is the case with 30 per cent aqua ammonia.

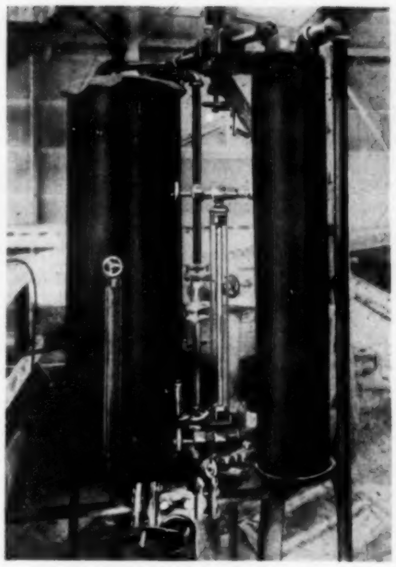
Due to its content of free ammonia, the liquor has a gage pressure of 30 lb. at 70 deg. F. and 65 lb. at 100 deg. F. The pressure at 100 deg. F. may be reduced to 25 or 15 lb. per sq.in. by the respective addition of 20 and 30 parts of water to 100 parts of the liquor. The resulting liquors contain respectively 45.6 and 42.3 per cent total NH_3 and 34.2 and 39.0 per cent water. The water content of these low pressure liquors is approximately one-half that of ordinary aqua ammonia, while their total ammonia content is 50 per cent greater.



After mixer is charged with superphosphate the operator opens the valve at the measuring tank and introduces urea-ammonia liquor

Urea-ammonia liquor is shipped in 11,000-gal. steel tank cars. When received at the fertilizer plant, the liquor may be used as shipped or it may be diluted as indicated previously. The temperature rise during dilution is small and in this respect the liquor differs from anhydrous ammonia.

In most plants equipped for the use of anhydrous ammonia, the urea-ammonia liquor can be handled in the same manner as anhydrous ammonia. The ammonia compressor is used for unloading the tank car and during ammoniation. The use of the ammonia compressor may, however, be eliminated by putting air on the tank car while unloading and on the storage tank during ammoniation. In plants having aqua ammonia equipment, the liquor is diluted as indicated above. The dilute liquor is then handled in the same manner and with the same equipment as is aqua ammonia.



Measuring tank for urea-ammonia liquor calibrated and fitted with a gage glass

The accompanying illustrations indicate the method of measuring and using the liquor in fertilizer manufacture. The urea-ammonia liquor flows into the measuring tank which is carefully calibrated and is fitted with a gage glass so the operator can deliver a given volume or weight of liquor into the fertilizer mixer. In practice, the mixer is charged with superphosphate; the operator then opens the valve at the measuring tank and introduces the urea-ammonia liquor while the mixer is being rotated. This is completed in about thirty seconds. The tank is again filled and the operation repeated. The usual operating cycle is two minutes, and the fertilizer charge is one or two tons. Potash salts and other fertilizer materials may be added to the superphosphate either, before, after, or during the treatment with urea-ammonia liquor.

As soon as the liquor is introduced into the fertilizer mixer, the free or inorganic ammonia reacts with the superphosphate to form ammonium phosphate, ammonium sulphate, dicalcium phosphate and, where large amounts of ammonia are introduced, some tricalcium phosphate. The urea in the liquor is precipitated in the fertilizer in such a finely-divided state and is so intimately mixed with the other constituents that its presence cannot be detected microscopically, but can readily be shown by chemical analysis. Experiments have shown that this method of introducing urea is better than introducing solid urea and ammonia separately, as it gives more intimate mixing, prevents segregation and reduces the tendency of the fertilizer to absorb moisture from the air. Since the urea does not react with the superphosphate, the fertilizer manufacturer can add 50 per cent more total ammonia by means of this liquor than he could with anhydrous ammonia. It has been a common practice to add 30 lb. of anhydrous ammonia in making a ton of 4-10-4 fertilizer. Using urea-ammonia liquor, the manufacturer will add a total of 45 lb. of ammonia, 30 lb. being inorganic and reacting with the superphosphate in the same manner as anhydrous ammonia. The other 15 lb., in the form of urea, will replace some of the more expensive and less available organic sources of nitrogen. Extensive factory-scale tests which include storage for several months have shown that all of the urea added in urea-ammonia liquor remains as urea in the finished fertilizer.

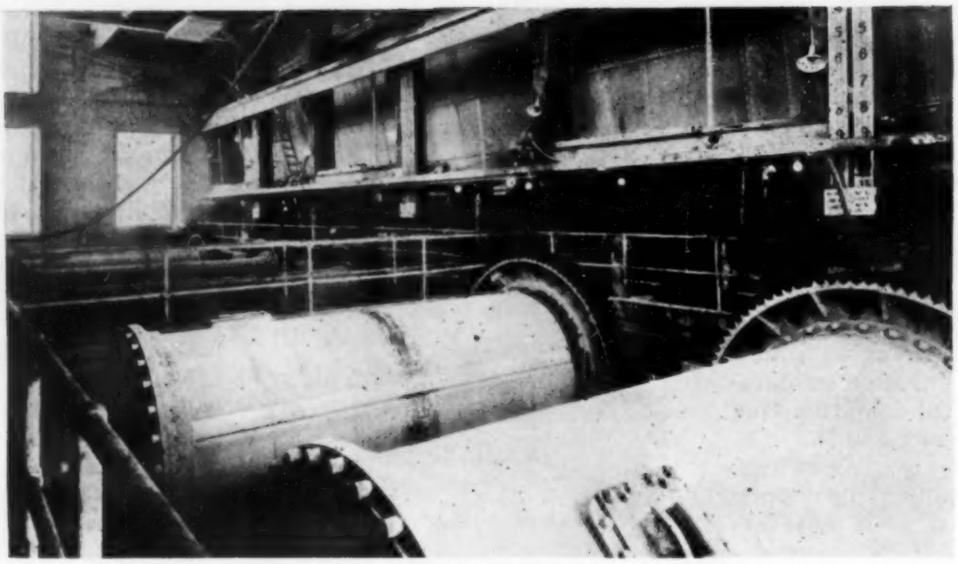
Urea-ammonia liquor is superior to anhydrous ammonia and other basic ammoniates because, per unit of ammonia added to the fertilizer, it produces the smallest increase in temperature. A high temperature rise in fertilizers is generally objectionable, as it tends to decrease the rate of ammonia absorption and to make phosphoric acid unavailable. Experiments show that per pound of ammonia added per ton of fertilizer, urea-ammonia liquor causes an average temperature rise of 1 deg. F., whereas aqua and anhydrous ammonia cause rises of 1.6 deg. and 2.3 deg. respectively.

Factory-scale tests have shown that up to 100 lb. or in some formulas 120 lb. of the liquor can be used per ton of fertilizer. The fertilizer cures quickly and the use of urea-ammonia liquor materially reduces caking in storage. The finished fertilizer is dry, but not excessively dusty and is in excellent condition for use in fertilizer distributing machinery. The "conditioning" action of the liquor is just as great as that of anhydrous ammonia and is superior to that of aqua ammonia. For example, certain lots of fertilizer have been shipped in less than a week after mixing, and in good condition.

Agricultural Value

The final test for any fertilizer material is its "availability" to important agricultural crops. The high agricultural value of the inorganic ammonia in urea-ammonia liquor is well established. It has the same availability as ammonium sulphate, but is superior in that it does not tend to increase the acidity of soils to the same extent as does ammonium sulphate.

Urea is generally recognized as an excellent source of nitrogen for all crops. Its high fertilizer value as a constituent of farm manure was known before synthetic urea was used as a fertilizer. Urea has been used extensively in experiments by the U. S. Department of Agriculture and several state Agricultural Experiment Stations. The results have shown that urea is superior to other organic sources of ammonia and is an exceptionally good source of nitrogen for tobacco, potatoes and many truck crops. Urea is not readily leached from the soil by heavy rains, and in this respect it is superior to nitrate sources of nitrogen. On being mixed with the soil, the urea soon decomposes to ammonium compounds and these in turn are gradually oxidized by soil bacteria to nitrates. The plant can absorb the urea as such or as the ammonium compound first formed or it may absorb the nitrogen as the nitrate. Unlike ammonium sulphate, urea does not cause a marked increase in soil acidity, although it is somewhat acidic in its action.



Battery of acid-resisting tube mills, grinding phosphate rock in weak phosphoric acid

Phosphoric Acid Imposes Severe Corrosive Burden

By WILLIAM C. WEBER

Chemical Engineer,
The Dorr Company,
New York, N. Y.

PHOSPHORIC acid is one of the more important mineral acids and in point of volume of production ranks well up with hydrochloric and nitric acids. While there are a large number of firms producing phosphoric acid for numerous purposes, by far the most important field from the standpoint of volume is the fertilizer industry since phosphorus is one of the three essentials of the fertilizer triad and since it is ideally suited to the binding of one other essential, nitrogen.

Of the two general methods for producing phosphoric acid, this article is not concerned with the oft-termed "thermic" process but with the second and more important available method for production of phosphoric acid by digestion of phosphate rock with sulphuric acid. In its present developed form it employs continuous digestion and continuous counter-current washing of the gypsum sludge. One modification, the Weak Acid Process, produces a phosphoric acid containing up to 22 per cent P_2O_5 while the other, the Strong Acid Process, produces directly an acid containing up to 32 per cent P_2O_5.

Phosphoric acid plants operate under conditions which subject the materials of construction to very severe service. Crude phosphate rocks contain a considerable quantity of silica and the resultant slurry is, therefore, highly abrasive. The solutions in themselves attack all but a few selected materials and this, added to the large quantity of slurry to be handled and elevated temperatures usually employed, introduce problems which thoroughly test the ability of the engineer.

Pure phosphoric acid should not be especially difficult to handle, but acid produced from phosphate rock by the wet process always contains small percentages of sulphuric and hydrofluosilicic acid. This last is especially destructive, because of its volatile reaction products. Another complication is that the solutions are usually saturated with gypsum, and sodium and potassium fluosilicates with their steep solubility curves and troublesome crystallization.

The company with which the writer is affiliated has built or has been associated with the construction of about 25 phosphoric plants during the past fifteen years. It has, therefore, collected information both negative

and positive with respect to materials of construction for this service which should be of interest to the chemical industry.

Some Materials Tried

Wood has been successfully used for agitator and thickener mechanisms in acids up to 22 per cent P_2O_5 in strength and at temperatures up to 70 deg. C. Its life, however, at the two maximums is quite short, and some other materials are probably more economical. For quite weak acids, say 10 per cent P_2O_5 or less, it is thoroughly satisfactory for many uses.

Synthetic resins have been found resistant to the acids but are structurally not very good, especially at high temperatures. A baked resin varnish finish has been used on an exhaust fan with quite good success. The use of rubber was limited for some time, due to deterioration at high temperatures but recently developed rubber covering is unaffected even at temperatures up to 80 deg. C. and with very strong acids.

In general, stoneware and high-silica, acid-resisting bricks and cement are thoroughly resistant to phosphoric acid. Where, however, the phosphate rock does not contain sufficient silica or sodium compounds to satisfy the fluorine evolved, stoneware may be subject to attack. Usually this is so slow that it is not serious.

None of the usual metals except lead is satisfactory for use with phosphoric acid. Lead is suitable, subject to its usual limitations of strength and softness. Out of contact with the solution, however, lead is attacked by the gases evolved and must be protected.

Alloys have been a very fertile field for study, but, of the tremendous number investigated, only a very few have been found to be entirely suitable, and it is with this class of material that the most discouraging results have been obtained. In a very large plant recently completed, a considerable amount of low-carbon, chrome-nickel-molybdenum steel was used and this has given almost complete satisfaction. Extreme care must be taken in its fabrication and heat treatment and it is necessary to re-heat the parts which have been welded, machined or mechanically processed in any way that might affect detrimentally the initial heat treatment. Hereafter in this article the steel which the writer has found suitable for this work will be referred to as a "special stainless steel."

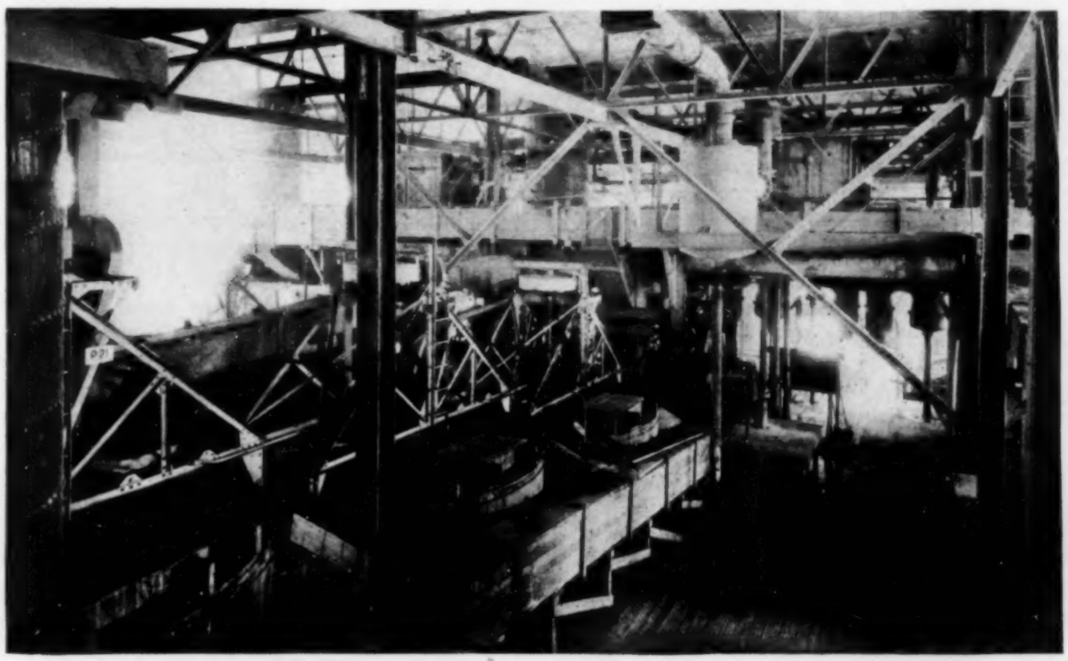
With the adaption of vacuum filters to strong phosphoric acid manufacture, the development of a suitable filter medium became of primary importance. Recently a new cloth, called Doracid, has been introduced and is in successful use in a large phosphoric acid plant handling acid up to 35 per cent P_2O_5 and at temperatures of 70 deg. C. It is made from a special, long-staple cotton and is nitrated after weaving. It has about the same thickness and texture as ordinary cotton filtration cloth, but has a much harder surface from which the cake is more easily detached.

Developed Operating Practice

The phosphate rock is either ground dry with air separation or, as is done in a very large number of plants, it may be wet ground in tube mills, using weak phosphoric acid as a grinding solution. In this latter case the shell, feed drum and discharge bell of the tube mill are constructed of iron and steel. All interior surfaces are protected by a special rubber lining, vulcanized to the metal in the shops by a process known as the Thermoprene process of the B. F. Goodrich Rubber Company.

After the shell and other parts are rubber covered, longitudinal wood strips are next applied directly over the rubber lining and upon this layer of wood is laid the final lining of imported silica blocks. The blocks are set in a special acidproof cement. The grinding media are selected flint pebbles from Denmark, while the manhole frame saddle and cover are of special stainless steel.

Rock digestion station. Three Dorr acid-resisting agitators in foreground



This construction, used in both strong and weak acid plants, provides, first, an impervious rubber lining to protect the metal parts from corrosion, second, a layer of wood to act as a buffer between the silica lining and the rubber-coated shell and, finally, a lining of blocks to stand the abrasion and shock of the cascading charge and pebbles. It is now preferable to use a completely rubber-covered drum type of feeder.

Digestion and Thickening

The agitation tanks may be of steel, wood or concrete. In the case of wood or steel tanks these must first be lead-lined and then the lead should be protected from abrasion and fluorine attack by wood or, preferably, a lining of acid-resisting brick. Concrete tanks have been successfully lined with a double layer of acid-resisting bricks, set in acid-resisting cement. Wood is the preferred tank construction except where the other materials are cheaper. The tank covers and ducts for venting fumes to the atmosphere may best be constructed of wood and it has been found desirable to impregnate these with paraffine. To date the Dorr type of agitator, using combined air and mechanical agitation, has been quite generally used. For weak acid work these are quite suitable if constructed of wood entirely below the solution level with bolts and fittings of special stainless steel or the equivalent. The raking blades are of a hard lead with an abrasive facing of imbedded grains of alundum.

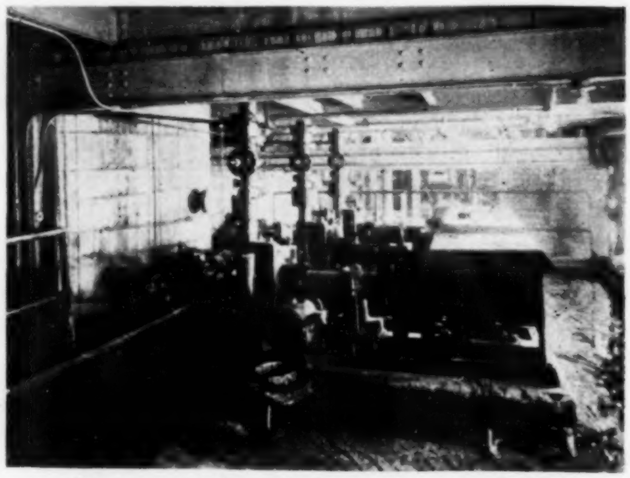
In the strong acid process the agitators may be either of the combined air and mechanical type or of the propeller type. If the former are employed, the submerged parts must be of rubber-covered construction with special stainless steel bolts and fittings. Mechanical agitators should preferably be of special stainless steel throughout.

Thickener tanks may be of wood or concrete construction. If of wood, they are lead-lined and provided with wood covers. Concrete tanks may be lined with acid-resisting bricks, set in acid-resisting cement. Wood is generally used for the shafts, arms and braces of the thickener mechanisms, all joined together with bolts and fittings of special stainless steel. The raking blades are made of plumbalun, the same acid resisting abrasive material that was used in the agitator. Rubber-covered steel would be entirely satisfactory where stronger acids necessitated some construction other than wood.

For filtering weak acid, as is quite often the case at the end of a decantation plant, the filter drum or shell may be of wood. For the direct filtration of strong acid, either in the weak or strong acid processes, the filter shell must be of cast lead or of rubber-covered steel construction. The latter is to be preferred because of its lower cost, lighter weight and the possibility of building filters of this construction in much larger sizes. All lead valves have been used but the latest development is to use a special stainless steel valve seat and an antimonial lead valve cover. This gives a very satisfactory combination. All filter cloth retaining bars, bolts, studs and other metal parts inside of the filter should be of special stainless steel construction. As previously mentioned, nitrated cotton or silk filter cloths have been successfully used for filtration of very strong acids. Metallic filter surfaces have been tried but these are very expensive and blind rapidly.

In the weak acid process, thickener underflows are handled by diaphragm pumps. The bodies are built of hard lead or preferably of rubber-covered iron and steel. The diaphragms are of rubber cord construction and both studs and yokes are of special stainless steel. Rubber-covered ball valves and rubber valve seats are used. Elsewhere throughout the plants acid sludges are handled by pumps of the centrifugal type. The sand type of pump without packing gland, such as the Wilfley, is greatly to be preferred, and pumps of this type with rubber-lined steel casings and special stainless steel runners and shafts have been very satisfactory.

Centrifugal pumps are used exclusively for solutions. In the case of weak acid, hard lead casings with runners of Illium have been used successfully but all stainless steel construction is to be preferred. For strong acid the pumps must be constructed entirely of stainless steel.



Battery of acid resisting Wilfley centrifugal sand pumps discharging through lead pipes equipped with stainless steel plug cocks

Troughs and launders are, of course, infinitely simpler and far more accessible than closed pipe lines. Good phosphoric acid engineering demands their use wherever practicable. Lead-lined wood construction is satisfactory for solutions, but an additional lining of abrasive-resisting brick should be used where sludges are to be handled or where concentrated fluorine fumes are present.

Piping Most Important

The piping arrangement and type of pipe and valves to be used are of paramount importance in phosphoric acid plants. A poor arrangement can cause considerable grief and loss of production. From a corrosive standpoint, lead pipes are entirely satisfactory. With some of the solutions encountered, however, they will very rapidly fill up with a crystalline scale and must be arranged so that they can be readily taken down for cleaning. For this reason it has been found preferable in many cases to use rubber hose. In this way sharp turns are avoided, the line may be dismantled easily and rapidly and crystallization may frequently be broken down and removed without disconnecting the line by simply flexing the hose at the point of restriction.

In operation under pressure or above operating floors, however, the use of rubber hose introduces a hazard, as the writer has encountered cases where they have burst.

For this service it should be of a special, acid-resisting construction, adapted to high-temperature service, and provided with molded and reinforced flanges like cast metal pipe. A preferred type is known as "pinch valve hose" with which it is possible to use steel clamps in place of ordinary valves. The hose should be heavily reinforced and suction line protected against collapse by spirally-laid, steel reinforcing. It is also necessary to have the outside of the hose thoroughly protected by a heavy, tough covering of acid resisting rubber.

If rubber-lined or lead pipe is employed, a lubricated, special stainless steel, plug cock is very satisfactory, especially for sludges. Cocks of this type may also be obtained in rubber-lined construction. Special stainless steel Globe Y-valves are excellent for non-crystallizing solutions and lead Y-valves are suitable for weak non-crystallizing acids.

Problems in Acid Handling

Concentrated sulphuric acid can of course be stored in steel tanks and weaker acids in lead-lined wood tanks. For phosphoric acid lead-lined wood construction is preferred. Abroad, some of the plants use steel or concrete tanks with a double lining of acid-resisting brick.

Very close control of the rate of feeding rock and sulphuric acid is of great importance in plants of this type, as well as control of the return of weak acid to the reaction. A rotating, scoop feeder of novel design, known as the Howard Acid Feeder, has been generally used in the latest plants for this purpose. The submerged parts are made of hard lead and the mechanism is installed in a welded steel tank for sulphuric acid feeding and in a lead-lined or, preferably, rubber-lined steel tank for phosphoric acid. Flow meters, siphon feeders, tanks and other such devices have been tried, but the crystallizing and corrosive nature of these solutions make anything but the very simplest type of feeder most undesirable.

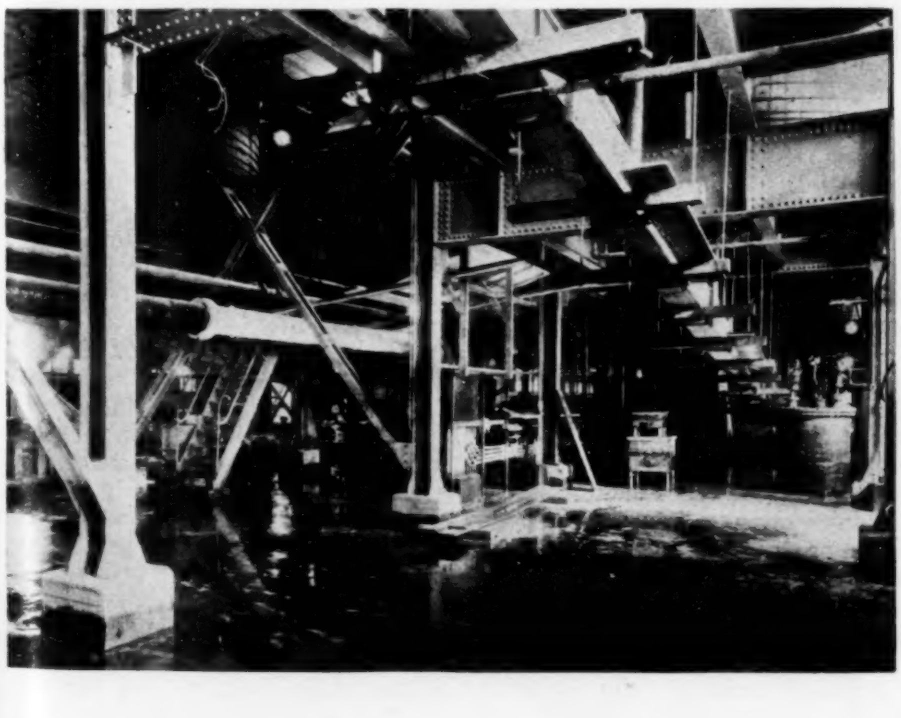
Phosphoric acid can, where absolutely necessary, be concentrated in single-effect vacuum evaporators or in so-called drum evaporators using direct combustion gases. The body of the evaporator proper should be of cast lead or lined with brick. Tube sheets can be of hard lead and tubes of lead-covered, copper tubing.

Supplementary Equipment

Fumes are evolved at several stages in the process, yet excellent working conditions can be maintained by the liberal use of fume ducts leading to scrubbing towers or to the atmosphere. The ducts themselves may best be made of wood impregnated with paraffin or of sheet steel, lined with rubber. The fans should be of acid-resisting construction. Rubber-covered fans are fairly satisfactory.

Fumes, dust and spillages are liable to come in contact with electric motors at many points in phosphoric acid plants, and for this reason all motors exposed to these hazards should be of the totally-enclosed type. All electrical equipment, switchboards, and so on, must be very carefully grouped and located with an eye to these hazards.

All operating floors should be very carefully classified as to whether they are subject to acid spillage or not. This acid plays havoc with floors and other structures. The best flooring is a well-drained concrete floor protected by asphalt wherever subjected to spills. Walkways and stair treads may be of steel grating. Steel building columns or equipment foundations should be thoroughly protected against acid spill. Columns where they pass through floors should be protected with a concrete asphalted base. Every one of the floors should be curbed.



Asphalt floor under the phosphate rock digestion station is acid resisting

Hard Times Fail to Depress ELECTROCHEMICAL ACTIVITIES

Cleveland sessions of Electrochemical Society marked by striking advances in photo-electric cells, electro-organic chemistry, and new industrial applications such as electro-pasteurization of milk

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EDITORIAL STAFF REPORT

THE sixty-second convention of the Electrochemical Society was one of the most attractive and successful in its annals. Throughout all the sessions a new keynote—"The depression is over!"—was clearly reflected in the countenances—if not the pocket-books—of all of the 300 members and guests. The enterprise of the Cleveland local committee headed by Clayton M. Hoff was to be seen in the carefully planned social functions, which included trips through the plant of the National Carbon Co. and the General Electric laboratories at Nela Park as well as to Akron to inspect the partially completed airship, *Macon*—an electrochemical product of the aluminum industry almost three times the size of the *Los Angeles*.

At the dinner on Sept. 22, Dr. Charles F. Burgess was presented with a parchment certificate of honorary membership in the society. His many inventions and accomplishments, notably in electrolytic iron and the dry cell, have gained for him world-wide recognition. Many of his publications appear in the Transactions of the Society of which he has served as president and also member of the Board of Directors for many years. He is a most enthusiastic and ardent exponent of electrochemistry.

After the meeting was formally opened by President R. A. Witherspoon of Montreal on Thursday morning, Dr. Charles L. Mantell covered in a striking and concise fashion "The Economic Importance of the Electrochemical Industries." It was a surprise to many to learn that the electrolytic caustic business is as big as that of anhydrous ammonia; that calcium carbide in its crude form means as much money as the entire sulphur business; and that the total value of the battery business is more than that of sulphuric acid, ammonia and lime put together. Power costs at Arvida and Shawinigan Falls, Canada, are as low as those of Norway and Sweden, 1.0 to 1.5 mills per kilowatt-hour.

The world's cadmium industry has increased tenfold in the last ten years. Many tons are today recovered electrolytically as a byproduct of the zinc industry. The bath employed by the large zinc companies is the sulphate bath, yet for one of the most important uses of cadmium, namely as a corrosion resistant coating for steel, the cyanide bath is employed. The deposit from the cyanide bath is usually finer and smoother. Accordingly, S. Wernick of the Sir John Cass Technical Institute, London, set out to determine the cause for this better plate from the cyanide bath and carried out a long series of tests studying the effect of pH, current density, and the temperature of bath. In no case, except when a colloidal addition agent was introduced into the sulphate bath was it found possible to produce a plate as "structureless" as the cyanide deposit.

Gustaf Soderberg, technical director of the Udylite Process Co. reported that cadmium plates from cyanide solutions discolor when stored without air circulation, particularly in warm and humid weather. The discoloration is greatly accelerated when a nitric acid bright dip has been used. The discoloration is probably caused by the action of moist ammonia fumes, formed by the disintegration of cyanide or ammonium salt residues on the surface of the plate. Discoloration can be avoided by means of immersion of the plate in an oxidizing solution prior to the final rinsing and drying. A suitable bright dip which also prevents tarnishing consists of a chromic acid solution containing active acid radicals.

Prof. A. K. Graham of the University of Pennsylvania described at length the investigation on anodes for zinc plating conducted by himself and George B. Hogaboom of the Hanson-Van Winkle-Munning Co. For the acid zinc sulphate bath the authors recommend a zinc alloy anode containing 0.5 per cent Al, and 0.3 per cent Hg. The anode current efficiency equals the cathode efficiency. Chemical attack by the solution and sludge formation are eliminated. Solution composition, especially the acidity, is practically constant. For the zinc

cyanide bath they also recommend the zinc alloy anode. Although showing an anode efficiency somewhat lower than the cathode efficiency it is superior to all other anodes tried in so far as there is no sludge formation.

In commenting upon the authors' findings Charles H. Eldridge, who presided, and others emphasized the deleterious effect of impurities in solution upon the quality and smoothness of the zinc cathode deposit. As little as 2 to 3 p.p.m. of Pb in solution will affect the quality.

The paper that was most controversial was that of Dr. L. C. Pan (College of the City of New York) on the formula of the "Complex Cyanides in Brass Plating Solutions." These have been generally represented by $Na_2Cu(CN)_3$ and $Na_2Zn(CN)_4$. By analyzing brass electroplating solutions of known composition by various volumetric methods, the author proved that the complex compounds in such solutions are $Na_2Cu(CN)_3$ and $NaZn(CN)_3$ and not $Na_2Zn(CN)_4$.

H. P. Coats of Firestone attributed the difficulty of ascertaining the true formulas for these complex cyanides to methods of analysis. Dr. Pan reiterated that the tests properly interpreted supported the formula, $NaZn(CN)_3$. W. L. Semon of Goodrich emphasized that there was an additional complication due to the marked tendency of the zinc to form zincate ions in the alkaline solution. M. R. Thompson of the Bureau of Standards felt that Dr. Pan's conclusions were not without question since in the presence of the strongly acid bisulphate of soda the cuprocyanide and cyanate are not stable. Much depends upon the method of determining "free cyanide." N. Promisel of the International Silver Co. believed that the formula for the zinc cyanide complex is dependent upon the free cyanide concentration. There may be a shifting even during the process of analysis. R. M. Wick of the Bureau of Standards presented evidence indicating that the complex copper cyanide ion may be either $Cu(CN)_2$, $Cu(CN)_3$ or $Cu(CN)_4$. Concluding the discussion Secretary Colin G. Fink recommended the time spent on cyanide baths be diverted to a study of complex mineral acid baths because "cyanide baths are so unstable."

"Stop me, if you've heard this one before."
Ex-president and newly honored member, Dr. Charles F. Burgess, listens to an old timer propounded by President R. A. Witherspoon.

L. C. Flowers and J. C. Warner of Carnegie Institute of Technology investigated the low pH nickel bath. If the *Ni* concentration, temperature of the bath and current density are high the throwing power is almost as good as that of the low pH baths. W. M. Phillips of General Motors found that the presence of iron had a very marked depressing effect on the throwing power. Max Schlotter and Joachim Korpium of Berlin, Germany, submitted mathematical formulae for the calculation of throwing power. Marcel Ballay of Paris, France, described "Ultra-Rapid Nickel Plating in France." An accurate method of determining gases in nickel and other methods was described by N. A. Ziegler.

An alloy coating for steel resistant to HCl was found by Colin G. Fink and Otis H. Gray of Columbia in the discovery that a perchlorate solution of lead and bismuth would give a deposit of an alloy of these two metals highly resistant to muriatic acid corrosion. The plate is ductile and practically free from pinholes.

Prof. J. C. Warner of Carnegie reported upon tests made by himself and Cyril Wells on the electrode potentials of iron manganese alloys. There are no abrupt changes on the "potential-composition" curve indicating solid solution over the whole range of composition.

A startling announcement was that of R. H. Boundy of the Dow Chemical Co. who said that his company had for years been using a 4,000-ampere conductor 850 ft. long consisting of iron piping filled with metallic sodium. The weight per unit conductivity is decidedly less than for copper and the cost per running foot of conductor is approximately the same.

Prof. Alexander Lowy of Pittsburgh presided. Recent progress in electro-organic chemistry was reported by Prof. C. J. Brockman of Georgia. Then followed C. H. Rasch and Alexander Lowy who had electrolytically oxidized anthraquinone in strong H_2SO_4 solutions and produced hydroxilated anthraquinones. Quinizarin was isolated from the mixture. R. H. McKee and E. Q. Adams discussing these results emphasized the importance of getting equilibrium conditions. Prof. Sherlock Swann, Jr., of Illinois reported upon the electrolytic reduction of methyl n-propyl ketone to n-pentane at a cadmium cathode. A dilute sulphuric acid catholyte was used. The optimum conditions were as follows: Current densities 0.05 to 0.15 amp. per square centimeter, acid concentrations, 30 to 40 per cent, temperature 60 deg. C. A maximum current and material yield of 74.9 per cent by weight of n-pentane was obtained.

Clifton Kerns, a recent graduate of Pennsylvania, has investigated the electrolytic reduction of well stirred aqueous alkaline suspensions of nitrobenzene both in open and in closed cells. In general, maximum current and material yields were obtained in closed cell experiments.

R. H. McKee and C. J. Brockman of Columbia made a number of experiments demonstrating their new method for electrolyzing organic solutions.

It has been found possible to use saturated aqueous solutions of the sodium salts of organic acids of high molecular weight and high solubility as solvents for many organic compounds which are rather insoluble in water under ordinary conditions. These are true solutions which respond readily to electrolytic reduction, forming

several kinds of reduction products which are not difficult to remove from the reduced solution. It is no longer necessary to use violent stirring to bring the organic depolarizer up to the cathode, nor is an easily volatile solvent necessary to bring the depolarizer into solution in the electrolyte. Reduction of aromatic nitro compounds offered the most interesting field for study.

E. G. White and Alexander Lowy described a new type of electrode which they successfully employed in the oxidation of naphthalene. The electrode consists of a platinum gauze having pressed into it a mixture of 60 per cent naphthalene and 40 per cent carbon. The electrode was subjected to oxidation under variable conditions.

A yield of 30.37 per cent of α-naphthoquinone was obtained under the following conditions: Temperature, 24–26 deg. C.; a one per cent sulphuric acid solution; anode current density, 0.861 amp./sq.dm. Discussing the authors' findings Professors Swann and McKee suggested trying out different forms of carbon, the authors having confined themselves to Darco.

Of popular interest was Dr. C. G. King's (University of Pittsburgh) paper on the pasteurization of milk. Alternating current is passed through the milk and the entire mass of fluid is easily and evenly heated with a minimum of exposure to either air or metals. Water-cooled carbon plate electrodes are used and the temperature is brought up in two stages; first, to 120 deg. F. and then to 162 deg. F. The pasteurized milk produced has been given repeated and thorough tests as to efficiency in destroying pathogenic organisms. The reports of these tests have been most satisfactory.

Commenting on King's results Dr. Lowy added that there were 17 plants already in operation utilizing the electrical heating method of King. L. C. Judson of the Acheson Graphite Co. suggested trying out different types of carbon electrodes, including impregnated ones.

Prof. H. H. Willard of Michigan described the research on the electrolytic oxidation of iodine that he and his student, R. R. Ralston, had conducted.

This oxidation was effected by means of a platinum anode in a solution containing HCl as the iodine carrier. A similar cell was used to oxidize iodic acid to periodic acid, in the absence of chlorides, using a lead dioxide anode. Both acids may be obtained in crystalline form by evaporation of their respective anode solutions.

Massachusetts Institute of Technology contributed a paper by Prof. M.deK. Thompson and A. L. Kaye on the oxidation of molybdenum in KOH solutions. The cadmium electrode for storage battery testing was discussed by Lieutenants W. J. Holmes and R. Elliott of the U. S. Navy. Prof. H. Kamura of the Meiji College of Technology described his results on hydrogen reduction of iron ores.

Saturday morning was devoted to a general discussion of the photo-electric effect. In describing the caesium-oxygen-silver photo-electric cell that he and M. J. Kelly of the Bell Laboratories had studied, Mr. Prescott emphasized that the essential conditions are a quantitative control of the degree of oxidation of the silver cathode and the amount of caesium generated, together with a regulation of the amount of chemical interaction, by a control of the time and temperature of the heat treatment. The active surface of the cathode appears to be a film of free caesium of atomic dimensions, adsorbed upon a matrix of caesium oxide and silver containing free caesium and a small amount of silver oxide. The spectral characteristics of the photo-electric response appear to depend largely upon the thickness of the surface film of free caesium.

The Bloomfield laboratories of the Westinghouse Lamp Co. submitted through J. W. Marden and K. O. Smith results on the use of the titanium photo-electric cell for the estimation of the erythemogenic values of 14 different types of mercury lamps.

In stressing the importance of Professor Dufford's researches Dr. W. C. Moore of the U. S. Industrial Alcohol Co. enumerated a number of organic compounds that ought to be investigated, adding that his company will be glad to furnish samples of these.

The new chrom-selenium cell by C. G. Fink and D. K. Alpern consists of Cr-Se films which are more uniform and stable in operation than are the straight selenium plates, and also allow a more satisfactory manufacturing control of cells of high photo-sensitivity. Photovoltaic cells of both the dry and the wet types, using the Cr-Se film, have been designed for industrial and laboratory applications where it is desired to determine the color or intensity of light.

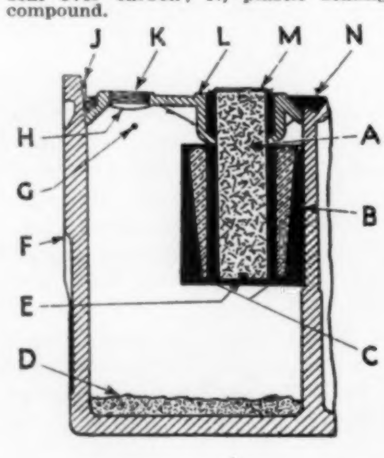
George W. Heise and Erwin A. Schumacher of the National Carbon Co. described the new air cell shown in the accompanying figure. The loose lime on the bottom of the cell reacts with the sodium zincate and sodium carbonate (CO_2 from air) in the electrolyte giving rise to insoluble precipitates. In the present development the immediate objective was a cell of at least 600 amp.-hr. capacity, large enough to supply a 0.5 to 0.6 amp. "A" current for a low drain radio receiver for a year.

George W. Nichols described the production of heavy electro-deposits of manganese dioxide as carried out at the Burgess Laboratories at Madison, Wis. The product is very pure but it contains a small percentage of lead. An acid sulphate bath was used and rhodochrosite was the raw material.

J. H. Critchett of the Union Carbide Co., Chairman of the Electrothermic Division of the Society, presided at an informal round-table discussion of the electrochemical possibilities at the Hoover dam. There will be available 660,000 firm horsepower. Transmission costs are higher than transportation costs for raw material or finished product. A large and wide variety of raw materials is available within short hauling distances of the dam. Prof. John A. Fulton of Reno submitted details as to the new copper deposits discovered near Mountain City.

New type of air cell before activation

A, carbon electrode; B, cast caustic soda; C, zinc electrodes; D, lime; E, iron rod for carbon support; F, battery container; G, wire to indicate proper solution level; H, frangible diaphragm; J, battery terminal; K, filler opening; L, top cover; M, removable seal over carbon; N, plastic sealing compound.



Facilitating Higher Vacuums in Industrial Processes

By D. H. JACKSON

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THE TENDENCY in recent years toward higher pressures in boilers and in many industrial processes has been very extensive. Hydrogenation of petroleum at 3,000 lb. above atmospheric pressure and catalytic processes for industrial synthesis at much higher pressures are well known. At the other extreme the observer of chemical engineering progress also finds extensive current developments in the field of low pressures approaching absolute vacuum. These developments may not be quite so spectacular, but they are responsible for substantial improvements in many chemical engineering processes as well as aiding in the recovery of byproducts and the development of new products.

High vacuum in the vicinity of 1 or 2 mm. absolute pressure was thought, not so many years ago, to be largely limited to laboratory apparatus. A field engineer employed by one of the manufacturers of vacuum equipment was ridiculed some years ago when he reported to his chief having seen a steam distillation process where the vacuum was considerably higher than that corresponding to the temperature of the condensing water.

Today the same thing is being done in numerous industrial units, but many plant operating executives have not yet taken advantage of the improvements which this higher vacuum offers. Those who have tried to produce the higher vacuum with reciprocating or rotary vacuum pumps have been successful only when handling small quantities of air or vapor.

Mechanism of High Evacuation

The steam jet type of vacuum producer (known as an ejector, evactor or thermocompressor) is the unit which has provided the high vacuum for most of the recent industrial developments in this line. The reason is comparatively simple but frequently is not recognized and, for the benefit of those interested in high vacuum, will be discussed here in detail. The density of any gas or vapor decreases in a definite ratio with higher vacuum. Gases of low density will flow with much less friction loss than those of higher density, which means that they can be made to flow at much higher velocities. They must flow at very high velocities in order to maintain a high vacuum on any continuous process where large quantities of steam or other vapor must be handled.

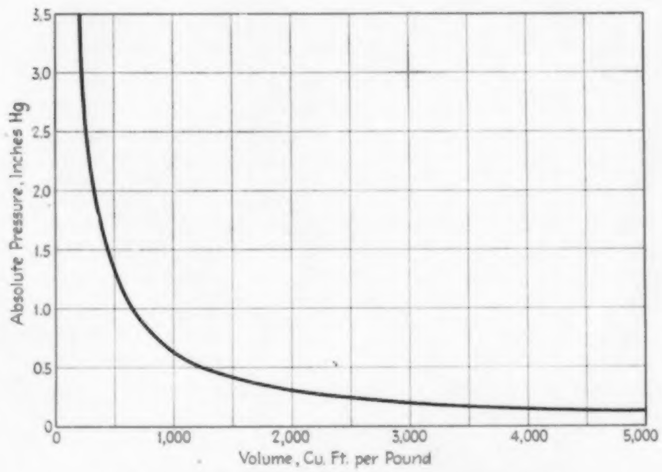


Fig. 1—Sharp increase in steam vapor with increase in vacuum

The average velocity of steam from the nozzles of steam jet evactors is about 4,000 ft. per second, which is higher than the velocity of a bullet.

The vapor from the vacuum vessel is drawn into a Venturi throat with this high-velocity steam. As the steam expands, the vapor is compressed and the two are discharged from the Venturi throat as a homogeneous mixture. The vapor passes through the ejector at velocities much higher than would be possible in any type of mechanical vacuum pump. In order for the latter to produce high velocities, the pistons or impellors must themselves move at equal or higher velocities. The energy required to move these pistons or impellors is a great deal higher than that required to move the vapor. In the steam jet apparatus there are no moving parts. The apparatus is perfectly rigid and the steam and vapor move through it. The low density of the entering vapor permits very efficient application of the energy of the expanding steam.

The importance of this high velocity through the vacuum producer is not fully realized until one considers the large increase in the volume of a vapor at high vacuum (see Fig. 1). Take, for example, a case of steam distillation of an organic liquid. Say the amount of blowing steam through the liquid in the still is 1,000 lb. per hour. The mixture of steam and organic vapor would pass first through a partial condenser where the vapor would condense. If a vacuum of 0.25 in. of Hg absolute is maintained on the system, the volume of steam leaving the condenser will be 2,415,000 cu.ft. per hour. It is now necessary to condense this steam and finally to discharge to the atmosphere any air which has

leaked into the system plus any non-condensable gases which may have been liberated in the still. The temperature corresponding to steam at 0.25 in. Hg vacuum is 40.2 deg. F. If this steam must be condensed by cold water or brine, a temperature of 32 deg. F. or lower would be necessary and a refrigerating plant of about 100 tons capacity would be required.

Comparison of Methods

Suppose the temperature of available condensing water without refrigeration to be 80 deg. F. maximum. It is then necessary only to compress the steam in a thermocompressor from 0.25 in. Hg absolute vacuum to 1.4 in., at which point there would be 10 deg. F. temperature difference between the condensing water and the steam. With this condition the steam could be readily condensed in a final condenser and the air and non-condensable gases discharged through a small two-stage steam jet to the atmosphere. The steam required in the thermocompressor would be approximately 2,400 lb. per hour, assuming that it is available at 125 lb. pressure. (The quantity of steam varies slightly with the pressure.) At an average cost of 35 cents per thousand pounds of steam, the additional operating cost for the higher vacuum would be only 84 cents per hour plus a smaller amount for pumping charges on the extra vloume of condenser water due to the live steam furnished to the thermocompressor.

While it would be highly impracticable to use mechanical vacuum pumps for the above service, it might be possible and a comparison of operating costs would be interesting. It would be necessary to compress 2,415,000 cu.ft. per hour from 0.25 in. vacuum absolute to 1.4 in., corresponding to a volume of 473,000 cu.ft. per hour. The pump must then have a displacement of approximately 57,400 cu.ft. per minute, figured on the basis of 70 per cent pump efficiency, which is above the average. No mechanical vacuum pump has ever been built for this large capacity. If it were possible to do it at all with mechanical pumps, literally dozens of the largest available pumps working in parallel would be required. Power costs would be many times greater than for the one thermocompressor unit which would do the same work.

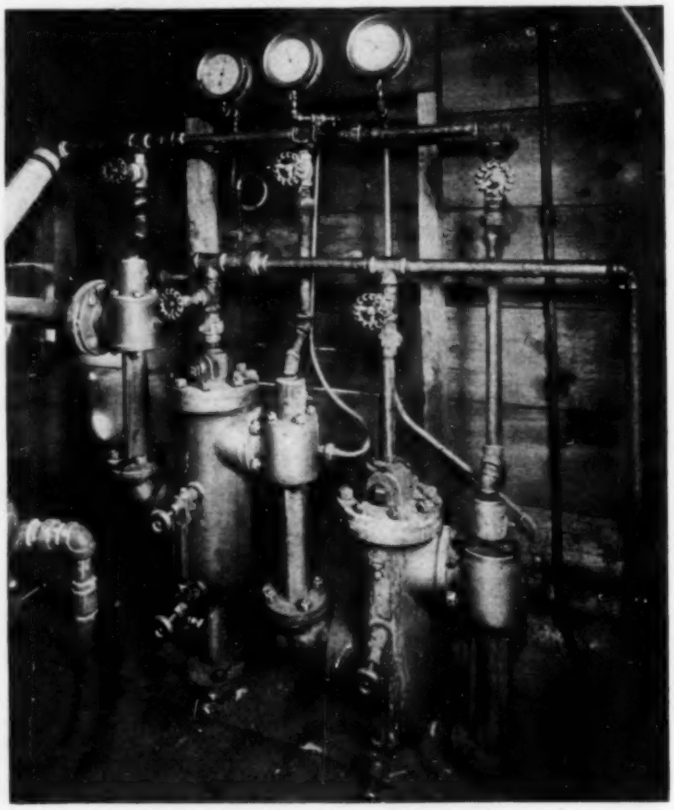
Steam Jet in Oil Industries

The petroleum industry has probably applied the above type of steam jet equipment more widely than any other of the process industries. On fractionating stills some of the low-boiling hydrocarbons cannot be condensed until they have passed through the thermocompressor. This is frequently an advantage in that it provides a convenient means of more completely separating some of the low-boiling and high-boiling hydrocarbons than practical by other methods. Within certain limits the separation point can be varied by changing the vacuum.

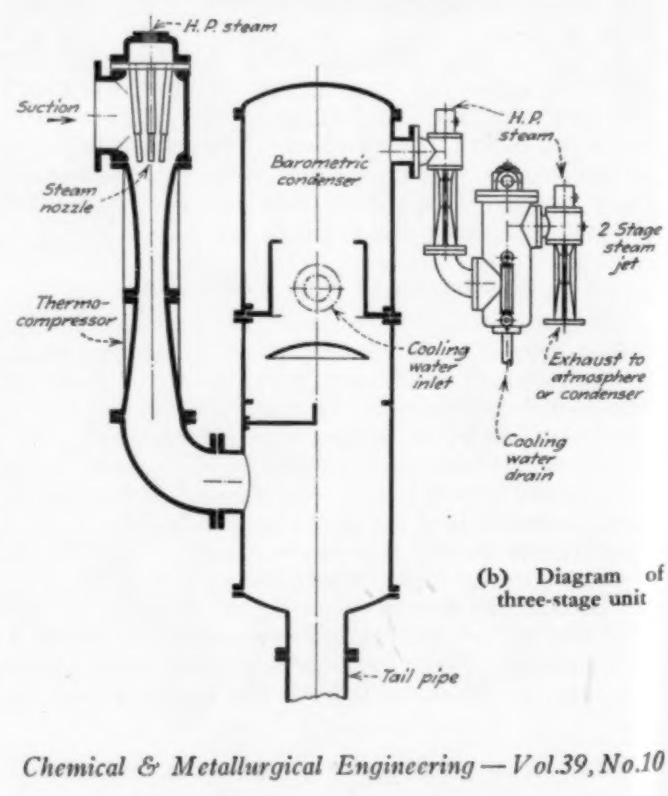
The vegetable oil industry has also made extensive use of the high-vacuum thermocompressor, principally for deodorizing purposes. This can be considered as a form of distillation in that the fatty acids and other organic impurities in the oil must be vaporized and separated at a high vacuum. The increasing use of vegetable oils as foodstuffs in recent years has been due in no small part to the high-vacuum deodorizing process which steam jet equipment has made possible. Products such as glycerine, aniline and numerous other organic liquids that are now distilled with the aid of blowing steam and a vacuum below that corresponding to the temperature of the available condensing water can be purified more efficiently by raising the vacuum and handling the blowing steam at the end of the process in a steam jet thermocompressor.

Probably the most recent and at the same time one of

Fig. 2—Typical commercial steam jet evacuators



(a) Photograph of installation



(b) Diagram of three-stage unit

the most important industrial improvements due to high vacuum is the vacuum refrigerating process. The idea of cooling water and other liquids by partial evaporation at high vacuum has been known for many years but has been applied on a commercial scale only very recently. A comparison of this process with mechanical refrigeration by means of ammonia or other refrigerant, is interesting. In the vacuum process water or brine is sprayed into a high vacuum chamber where a small quantity is evaporated, the bulk of the liquid being cooled at the expense of the latent heat of evaporation. The quantity of liquid evaporated is small, amounting to only one per cent for each 10 deg. of cooling range in water or aqueous solutions. The vapor from the evaporation is handled through a steam jet thermocompressor and discharged into a surface or jet condenser fitted with a small two-stage steam jet for handling air leakage.

The entire process involves no moving parts with the exception of a circulating pump for the cooling chamber. The process offers the additional advantage of applying the refrigeration direct to a liquid rather than transfering the heat through metal surfaces as is necessary with ammonia and other forms of mechanical refrigeration. It has the limitation, however, of being able to cool no lower than 35 deg. F. without excessive steam consumption. Mechanical refrigeration, therefore, will receive no competition from the new vacuum process for temperatures around the freezing point of water and below. For temperatures of 35 deg. F. and above, the vacuum process has obvious advantages of greater simplicity, lower first cost and equal or lower operating cost.

When cooling water to 45 deg. F. for air conditioning, the steam consumption of the vacuum unit averages about 25 lb. of steam per hour per ton of refrigeration. If it is necessary to cool it to 35 deg., the steam consumption is increased by approximately 50 per cent. Of course, the quantity and temperature of condenser water available effects the steam consumption. By using more or cooler condenser water the steam consumption can be reduced. On the other hand, if the water supply is limited a larger amount of steam can be used permitting a higher temperature in the condenser and a smaller quantity of condenser water.

Supplementary Evacuation

The above discussion has been confined largely to vacuum applications where large volumes of vapor are handled in the vacuum equipment. Substantial improvements have also been made in vacuum equipment for conditions where the vapors are all condensed ahead of the vacuum apparatus and only the air leakage and non-condensable gases must be handled. The distillation of lubricating oil offers a good example. A commercial vacuum of 2 mm. is frequently applied and recent improvements in the design of steam jet apparatus have reduced the steam consumption and in some cases have made it possible to operate as high as 1 mm. absolute when conditions are favorable. The steam consumption on this type of installation is a very small fraction of that required for the thermocompressor which handles large volumes of vapor. Of course, some non-condensable vapor and air leakage is always present and the ability of steam jet equipment to handle appreciable quantities of such vapor at 2 or 3 mm. absolute pressure is very much more important than is generally recognized.

The trend toward higher vacuum is apparent in many industrial processes other than those mentioned above, including drying, impregnating, evaporating, packing of food products, etc. Steam jet vacuum equipment has played an important rôle in this trend. Recent improvements in other types of vacuum producer have also contributed substantially to increasing advantages which industry has derived from more vacuum and higher vacuum.

The simplicity of steam jet vacuum equipment is all that could be reasonably desired, a single stage unit consisting only of a steam nozzle, fitted in a small suction chamber which is attached to a combining throat. Two- and three-stage units which are necessary for high vacuum are equally simple, the lower stages being practically the same as the first stage with the exception that capacities may be different. A photograph and drawing of typical apparatus are to be seen in Fig. 2.

It is very rare that conditions in different plants are sufficiently alike that duplicate units can be used. Any variation of steam pressure, degree of vacuum required, volume of vapor to be handled, temperature or quantity of cooling water available and some other factors usually require variations in design. Extreme precision is necessary in machining the steam nozzles and throats and considerable engineering ingenuity and test work is necessary to get a properly balanced design.

As is the case with most other equipment, operating experience has been the best source of information, particularly in regard to the important question of suitable construction materials. Considering the unusual simplicity of steam jet equipment and the total absence of moving parts it can be expected to last indefinitely. Cases have been known, however, where combined corrosion and erosion entirely destroyed nozzle holders in high-capacity thermocompressors in approximately one year's time. Of course, such experiences have been exceptions to the general rule of eight or ten years' service before corrosion has interfered with operation.

In the early part of this discussion a comparison was made of steam jet equipment against mechanical vacuum pumps for handling 1,000 lb. per hour of steam at 0.25 in. Hg absolute. While the steam jet apparatus has everything in its favor for this and similar conditions, some other conditions can be handled better with mechanical type pumps. For example, the extremely high vacua running into small fractions of a millimeter are impossible with steam jets and can be obtained best with mercury-vapor or some other form of rotary pump. The air-handling capacity of any pump at these high vacua is necessarily extremely small.

It should also be mentioned that mechanical pumps operate with slightly better power efficiency than steam jets for low and intermediate vacuum between atmospheric pressure and about 100 mm. absolute (26 in. referred to a 30-in. barometer). It is in the range of vacuum higher than 100 mm. absolute that the relative volume of the vapor becomes so great that the high velocity of steam jets handles it with less energy. Of course, the simplicity and negligible maintenance cost of the steam jet is always in its favor, also the fact that its exhaust steam can frequently be used for heating purposes, thus increasing the over-all efficiency.

An Introduction to

CHEMICAL PLANT DESIGN

Written chiefly for the younger chemical engineer, this article and those to follow will none the less merit close attention of seasoned plant designers. Later, Mr. Woodward plans to use actual cases in demonstrating his methods

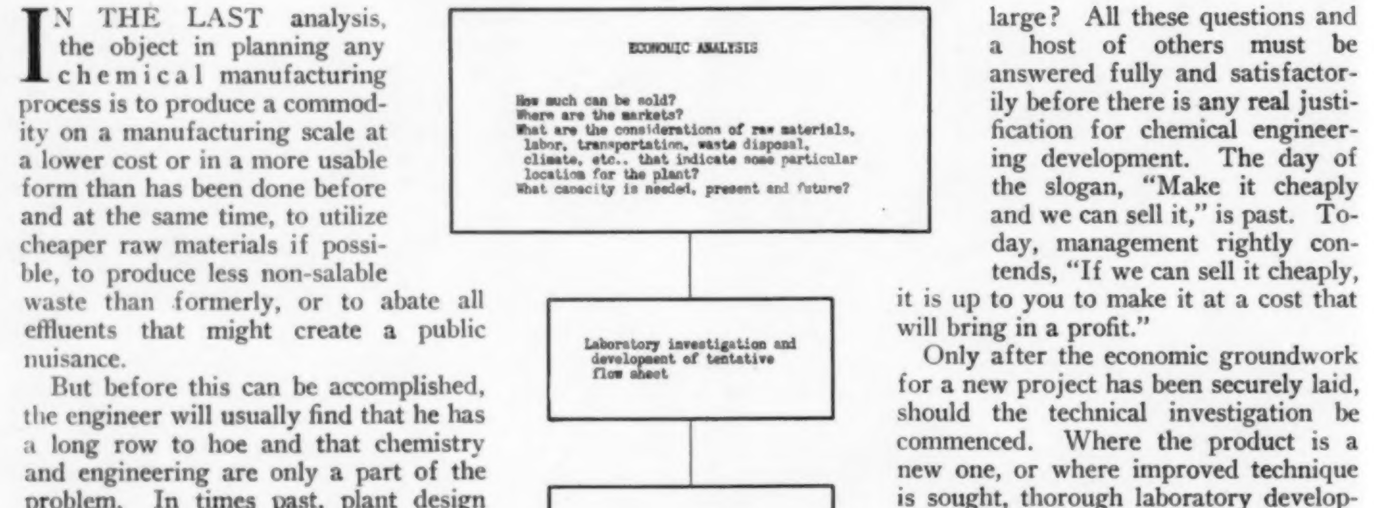
By ROLAND WOODWARD

Chemical Engineer
Wilmington, Del.

IN THE LAST analysis, the object in planning any chemical manufacturing process is to produce a commodity on a manufacturing scale at a lower cost or in a more usable form than has been done before and at the same time, to utilize cheaper raw materials if possible, to produce less non-salable waste than formerly, or to abate all effluents that might create a public nuisance.

But before this can be accomplished, the engineer will usually find that he has a long row to hoe and that chemistry and engineering are only a part of the problem. In times past, plant design was first, last and always a matter of engineering with a mere tinge of economics. Today, no less than then, design must involve the best of engineering but, throughout, the problem is also one of economics—is there a market; where is it; how large is it; at what price can the commodity be sold; what is the competition now and possibly in the future; what are the considerations of markets, raw materials, labor, transportation, waste disposal, climate, taxes, topography and a hundred and one lesser details that militate for one location as against another? In other words, shall the plant be built at all, and if so, when, where and how large? All these questions and a host of others must be answered fully and satisfactorily before there is any real justification for chemical engineering development. The day of the slogan, "Make it cheaply and we can sell it," is past. Today, management rightly contends, "If we can sell it cheaply, it is up to you to make it at a cost that will bring in a profit."

Only after the economic groundwork for a new project has been securely laid, should the technical investigation be commenced. Where the product is a new one, or where improved technique is sought, thorough laboratory development is then called for and on the basis of this work the engineer may go ahead, preparing his preliminary flow diagrams, rough estimates and designs. Through such tentative estimates, he will be enabled to form a more intelligent evaluation of the ultimate practicability of the process and obtain a better understanding of the relative importance of plant first-cost and operating-cost. Before more time and money have been spent on the development, he will be able to head off any obviously impracticable process, or to focus attention on phases of the work that are seemingly out of line with the rest of the development. Without such preliminary work,



earlier estimates of the commercial worth of the process are apt to be very misleading.

For the next stage, it will ordinarily be expedient to translate the results of the laboratory to the plant through the medium of the semi-works plant. Here design details as regards materials of construction, capacities and reaction characteristics can be developed with a fair degree of accuracy and the preliminary flowsheet and cost estimates can be checked. Operating details can be worked out in a preliminary way and much of the "grief" that will otherwise be inevitable when the plant is put into operation can be side-stepped at comparatively small cost. It will often be possible to carry on the semi-works plant development coincident with the final laboratory work, relying on the two to provide a sufficiently close approach to true plant conditions to justify the layout of a final flow diagram.

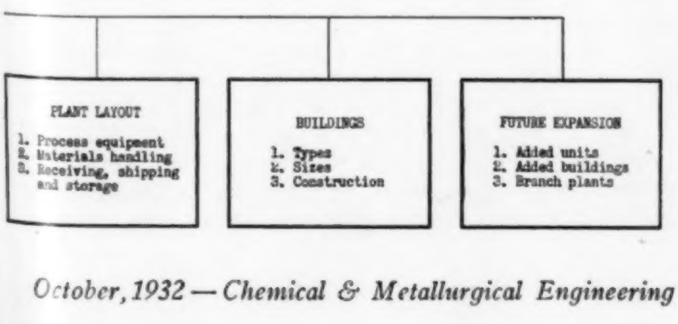
Going to Plant Scale

From this point on, the engineer will find himself engaged in the actual details of design. Realizing that semi-works results are not directly applicable in the plant, he must make the necessary allowances dictated by experience and indicated by a study of the factors that are next to be considered. While the semi-works plant will have given him a workable idea of reaction times, efficiencies and capacities, it will ordinarily have supplied little information in regard to the multitude of details of operation not directly concerned with the carrying out of the reaction.

First he must consider his raw materials in relation to their sources, their methods of receipt, storage and handling within the plant. Proceeding from the raw materials, he will next be concerned with the finished products, their form, their handling, storage and shipment. Parallel to the finished materials are the wastes which must be disposed of, either as salable byproducts or in some manner that will prevent their becoming a public nuisance.

Power services are of immediate interest in the following stage, and process equipment must be considered. Proper types and capacities must be chosen with regard to their materials of construction. A consideration of the topography of the plant site will determine whether advantage can be taken of natural variations in elevation to effect economies in the handling of materials. Equipment chosen can then be arranged for most economical operation and the number, type and construction of the buildings determined. In so doing, it is, of course, necessary to examine the question of future expansion and the possibility that branch factories may prove an ultimate need.

A study of the raw materials used in any given process brings up, first of all, the questions of the quantities to be used over various periods of time, the volumes received at the plant and, consequently, the sizes of main and temporary storages. For example, one process in which the writer was interested recently had to do with a raw material that required the gathering of a year's supply within only four or five months of the year; it was of enormous volume and of little value. Among the main problems in this case were the handling and storage since the finished product had a volume only about 2½ per cent of that of the raw material.



In the case of solid raw materials, it is necessary to know whether they can be received in bulk or in standard containers (*i.e.*, barrels, drums, etc.) and so stored; and also, if the material is in bulk, whether it must be loaded into temporary containers to facilitate charging into the different pieces of apparatus. Sources of supply will determine the quantities of the different materials to be carried in storage. Liquids may be received in tank cars or in any of the standard sizes of drums. Tank car shipments are to be preferred from the operating-cost point of view, even though this may involve a higher plant cost for suitable storage. (This is, however, a question of balance between the two costs involved.)

The study of proportions of weight and bulk of the raw materials to those of the intermediate and finished products has to do mainly with the space to be allotted for storage of the several items and the methods to be used for handling them in and out of storage. In some processes, it is necessary to store some of the intermediate products for various lengths of time to allow them to age or ripen before they are in condition to use.

Determining Shipping Facilities

What form the finished material has, plays an important part in this study. This form is determined by the ultimate use of the material and by its immediate disposal after leaving the factory. Some materials, like silicate of soda, for example, may be shipped either in tank-car lots, 110-gal. drums or in 1-gal. containers. Loading into the shipping containers in each of these three cases involves a different layout of the shipping end of the factory; and facilities for handling all three might be necessary. The loading of tank cars would require a suitable loading dock, its size depending upon the number of cars to be filled at one time. If loading were into drums, there would be required a suitable filling station, skids for storage, and so on. Or if the product were sent out in small containers, suitable equipment would be required for filling, labeling and packing into shipping cases. In this case, facilities would be needed for storage of knock-down shipping cases, for setting up these cases, for getting them to the filling room and then for moving the loaded cases to the shipping room or to storage. Obviously, the types of storage will be different for finished materials subdivided for shipment in different ways.

Similarly, solid materials may be shipped loose in box cars or packaged in barrels, boxes or cartons. Gases may be compressed into suitable cylinders ranging in size from tank cars down to the smallest size of sample bottles.

Proximity of a factory to the market for its products will have an important bearing on how the product is shipped. Auto-truck shipments may be of considerable importance, not only as a means of quick transportation to market, but as a way to avoid the construction of large

storages for outgoing finished materials as well as incoming raw materials and supplies.

A study of the wastes produced by the process will be highly desirable, both because of possible sales value to other industries and on account of possible utilization in the making of salable byproducts. Frequently, utilization of a waste material is overlooked in the desire to place the main process on a production basis as soon as possible. A little more thought and study might thus permit a material credit to the cost of the main product.

Avoiding Nuisances From Wastes

On the other hand, certain factories require disposal in some way that will avoid the creation of a public nuisance. Many localities have rather strict laws covering factory wastes. These laws frequently make necessary the construction and operation of more or less elaborate equipment for neutralizing or otherwise rendering harmless many gaseous and liquid wastes.

Solid wastes usually require the inclusion in the plant layout of a suitable dumping ground and means of conveyance to it from the factory. Pumping of sludge or the moving of filter cake in tram cars are the usual ways of transporting solid wastes. Care must be taken to locate the dumping ground so that dried solids will not become a wind-borne nuisance as this may be a serious matter in the disposal of certain solids such as gypsum.

Power, in some form, is used in every manufacturing operation. An estimate of the requirements for different kinds of power (*i.e.*, steam, electricity, compressed air and refrigeration) is necessary at the end of some one stage in the development of a process for it plays a vital part in the make-up of the plant first-cost and plant operation-cost.

If the proposed factory is to be an addition to an existing plant, the power requirements usually can be taken care of by the construction of an addition to the present power house, if there is one. In this case the costs of the several kinds of power can be estimated with a high degree of accuracy. The same is true of power purchased from either a public utility or an outside, neighboring concern.

However, when it is necessary to construct a suitable power plant as a part of the proposed factory, then careful study should be made of the requirements in order to design an installation that will attain a proper balance between electrical and steam loads. Modifying processes to permit use of either high- or low-pressure steam; use of turbine exhaust for heating; and use of group drives with proper synchronization of loads are methods of simplifying power requirements without restricting factory operation.

Designing the Equipment

After the approximate manufacturing program is known, it becomes necessary to determine in detail the equipment required for the production of a given quantity of output. The flow sheet previously worked up from experimental data shows the sequence of steps in the process as well as the time for carrying out the various parts of each step. The quantity and time factors must be built up to the times and sizes required to carry out the operations on a plant scale large enough to give the necessary output, with a safe margin to allow for contingencies. Having accomplished this, the engineer's next step is the choice of suitable equipment, using as data the physical and chemical characteristics of the reacting substances involved in each piece of equipment; and the physical and chemical changes undergone during their stay there. The interpretation of laboratory (or even semi-works) data in terms of large-scale production takes considerable care since direct increase of proportions is apt to give results that are very misleading. This is particularly true, for example, in equipment requiring heat transfer or agitation. The design may be not only a question of fundamental laboratory research but usually does involve such items as the heat transmission requirements of the materials in process, method of heating or cooling, radiation losses, degree and kind of agitation, etc. Often, the ultimate choice of materials of construction for many pieces of equipment can be satisfactorily determined only by experiment on a small scale.

Frequently, standard equipment will be available and the engineer's choice should favor it whenever possible, even though it may not be exactly suited to his needs. Specially constructed equipment is expensive both in first cost and in maintenance and repairs since replacement parts must usually be made to order. On the other hand, standard equipment is easily and quickly obtained, is much cheaper originally, may be readily duplicated, and has a greater resale value than does specially designed equipment.

Completing the Flow Diagram

As soon as decisions have been reached in regard to the types and sizes of equipment, either standard or special, the factory-scale flow diagram should be made as complete as possible. It should show the number of units of equal size required for any one operation in case one unit alone cannot, or should not, be used for that particular operation. Detail and assembly drawings should be made or obtained from the manufacturers so that the work of laying-out may proceed.

What type of site is available for the plant may have considerable influence on subsequent stages of the design. Hence, if it is practicable to do so, a careful study should be made of the topography of the proposed site in order to utilize differences in ground elevation for gravity flow of materials in process and to plan suitable connections with railroads and highways. Not long ago the writer visited a plant where the boiler house was literally set on a hill in order, as he was told, to get it out of the way of future expansion. But as luck would have it, the expansion took place in the lower part of the property and made it necessary either to throw away the condensed steam from several heating operations or else to pump it back up hill to the boiler house. Now, when the plant was first laid out, if the boiler house had been placed in the lower part of the property, even in the face of seeming interference with possible future expansion, this situation would not have arisen and a costly pumping operation would have been avoided.

Actual layout can next be started. Knowing the equipment required in a given department, the best procedure in making a layout is to cut out templates to scale from a fairly stiff paper. These represent each item of equipment on which is marked the locations of the several important pipe connections, driving mechanism, charging and discharging openings, and so on, all of which may be

obtained in the case of standard equipment from manufacturers' assembly drawings and catalogs. Considerable time should be spent in planning the layout of a given department and all the requirements must be taken into account, especially those of future expansion, always keeping in mind the department's place in the general scheme. Arrangements will, of course, be made in the most advantageous manner so as to secure the least handling of materials, compatible with safety of operation. Sufficient room must be allowed to provide access for adjustment and repair of all parts of a piece of equipment and to allow for its removal when necessary.

When the layout of each department has been prepared separately, the next step is the arrangement of the several departments and their inclosing buildings with respect to each other. It is not advisable to consider the proportions or the locations of the various departments on the plot-plan until there has been determined for each department its equipment, equipment space, and storage spaces for materials in process, etc.

Correlating Production Steps

The flowsheet will indicate that certain intermediate products must arrive simultaneously at certain stages of the process. It then becomes necessary to see that the departments and buildings are so arranged as to bring this about, following always the lines of least resistance so as to cut down the lengths of haul from one operation to the next. The flowsheet will also suggest the best locations for the storage of raw materials, intermediates or materials in process and finished materials.

Lockers, wash rooms and toilet facilities should be so planned that thorough discipline and order can be maintained as these incidental features are bound to react on the work of the plant as a whole. It goes without saying that such items as heating, lighting, ventilation and fire protection should be given all the consideration they deserve.

In the chemical manufacturing industry, the type of building used to house a plant is of great importance, mainly on account of maintenance. The buildings should be in keeping with the probable life of the process for money should not be tied up in buildings of more or less permanent construction (*i. e.*, concrete or steel and brick) when the process is likely to make necessary extensive changes within a few years. While there is much in favor of designing a building to inclose a group of equipment ideally assembled, it is frequently more desirable to use standardized buildings on account of their cheapness, especially for operations which may be more or less temporary in nature.

Buildings of one story in height are desirable for those operations that can be carried on advantageously on approximately one level, using platforms to gain slight differences in elevation. They are excellent for medium and heavy work, even where land is costly, for traveling cranes can be easily included in the building plans. Consideration must be given, however, to the question of whether the fixed charges due to increased cost of building and land will not be in excess of the economies gained by cheaper supervision, cheaper handling of bulky materials, better ventilation and better and cheaper lighting. On the other hand, multi-story buildings are best suited to those operations that can utilize gravity flow of materials in process, either as solids or as liquids. Frequently the answer to the problem will be the use in the plant of a combination of both types, each to meet the needs of the departments concerned.

Building Safety Into the Layout

Where operations are hazardous, as in the manufacturing of explosives, safety lies in cutting up the plant into small units. By so doing, the loss of life and property in case of accident will be kept to a minimum; also, the chances are reduced of the plant being put entirely out of operation. However, small units are more costly to build and operate. They require more supervision, labor, power, building and equipment per pound of output. Generally speaking, the proper size of the unit to be constructed will be determined largely by the hazards of the operation, chances of breakdown disrupting the remainder of the plant and the sizes and costs of the major pieces of equipment.

For those plants which are more or less permanent by reason of their nature, operating buildings should be constructed of concrete or steel and brick or hollow tile, especially if multi-story. A building, comparatively cheap in first cost, is one having a steel frame covered with either corrugated asbestos board or asphalt-and-felt-protected, corrugated steel sheets; such a building may be either single- or multi-story. For many operations, it is an ideal type of construction as the cost of maintenance is reasonably low. Another type of construction, well suited for certain classes of operations requiring a single-story building, has a wooden frame well protected by a suitable paint and covered with either of the corrugated sheets mentioned above. In such a building, operations producing fumes corrosive to steel, such as the manufacture of inorganic acids, can be carried on.

Providing for Future Expansion

Although it is almost impossible to tell in just what direction future expansion of a plant will take place, it is necessary that the layout of the plant be made to make possible the addition of equipment at the most logical places to take care of future growth. This is of utmost importance in the layout of a plant for a new process, as it has been the writer's experience that provision for the future addition of a piece of equipment here and there to take care of high-pressure production is well worth while. Even though a process is carefully studied out on a semi-works plant scale, the best working capacity of each piece of full-sized equipment is often quite difficult to ascertain beforehand. This is especially true in most of those cases where standard equipment is used in place of equipment that has been specially designed.

In the provision for future expansion on a major scale, some processes permit doubling up by merely repeating the equipment in a parallel line. Others make necessary an entirely new layout duplicating the original, owing, perhaps, to a grouping of the operations required to carry on the process. In general, however, it is usually possible to foresee some sort of future expansion and to make provision for it without unduly adding to the cost of the plant. This part of plant design is worthy of more study than is usually given to it since it may eventually mean the abandonment of the whole plant if growth has taken place along lines for which room has not been provided. More than one company has had to find a new location for just such a reason.

Slide Rule Simplifies Gas Calculations

By PAUL F. MARX
Wilmette, Ill.

GASES, unlike liquids, are compressible and their volumes for ordinary engineering calculations vary according to the Boyle's Law equation, $PV = P_1V_1$. The engineer who deals with gases must constantly apply this law and the task of so calculating weights and volumes becomes laborious, even though he may know the gravity of the gases and their percentage composition.

Proper tables, containing weights of gases at certain temperatures and pressures, from which to start calculations may not always be available. For this reason the slide rule described in this article has been developed. By the use of this rule, most problems may be very readily worked without the use of tables.

As a direct relation exists between molecular weight, specific gravity, temperature, pressure, weight, and volume of a gas, it is possible to apply this relation, through the use of logarithms, in the construction of a slide rule. The basis of the rule is the relation of molecular weight to the weight of a gas in pounds per cubic foot which, in conjunction with the laws of Boyle and Charles, gives all the data necessary to construct the scales. The scales have been arranged in such a manner that their movement accomplishes multiplication and division of the proper constants.

The relationship between the molecular weight and the weight of the gas in pounds per cubic foot at standard conditions (760 mm., 0 deg. C.) is shown in the following equation:

Molecular Weight $\times$ 0.002788 = Pounds per cubic foot

The volume of the gas at any pressure or temperature is then the reciprocal of its weight under the existing conditions and may be read in cubic feet per pound of gas. The rule satisfies the equation

$$W = \frac{144\ mP}{1{,}544\ (t + 460)}$$

where m = molecular weight; P = pressure, pounds per square inch; t = temperature, deg. F.; and W = weight of gas, pounds per cubic foot. This is one method of stating the perfect gas law.

The following example will illustrate the operation of the rule:

A gas mixture at 60 deg. F. and 200 lb. per square inch absolute pressure contains 80 per cent CH_4 (methane) and 20 per cent C_2H_6 (ethane). It is required to determine (1) the weight of the mixture in pounds per cubic foot; (2) the volume in cubic foot per pound; (3) the specific gravity (air = 1.0); and (4) the molecular weight.

Solution—Set the arrow on the small slide to the temperature of 60 deg. F. on scale *C*. Move the large and small slides together so that the line representing 200 lb. pressure on scale *B* coincides with the line marked "CH_4" on scale *A*. Under "80-per cent" on scale *D* read 0.461 lb. per cubic foot on scale *E*. Thus, 0.461 is the actual weight of CH_4 in pounds per cubic foot in the mixture at 200 lb. per square inch absolute pressure and 60 deg. F.

With the arrow of the slide still set at 60 deg. F., move the slide so that the 200-lb. mark coincides with the line marked C_2H_6 (scale *A*), and under the "20-per cent" mark read the weight of the ethane in the gas, which is 0.215 lb. per cubic foot. Adding these two weights of 0.461 and 0.215, we have 0.676 lb. per cubic foot, which is the weight of the gas mixture.

Reading under 0.676 lb. per cubic foot, we find the volume of the gas mixture to be 1.48 cu.ft. per pound (scale *F*).

Leave the rule set at 60 deg. F. and place the 100-per cent arrow of scale *E* against the 0.676-lb.-per-cubic-foot line. Over the 200-lb. mark on scale *B* read on scale *A* the molecular weight of the gas mixture, 18.8, and the specific gravity of the gas, 0.63 (air = 1.0).

Now that the method of operating the slide rule is known, let us work a problem of the sort in which it would actually be used.

Suppose that we desire to know how many gallons of water could be picked up per hour by a flow of 120,000,000 cu.ft. per day of 0.60 gravity gas at 60 deg. F. and 14.7 lb. per square inch absolute pressure, if the gas were 100 per cent saturated and the line pressure were 600 lb. per square inch Abs. at a temperature of 60 deg. F.

The sum of the partial pressures of a gas mixture equals the total pressure of the mixture, therefore, when P = the vapor pressure of the water and $\frac{p}{(600\text{-}p)}$ = the ratio of water to gas,

$$\frac{p \times \text{molecular weight water vapor}}{(600\text{-}p) \times \text{molecular weight gas}} = \text{Pounds of water vapor per pound of dry gas.}$$

From tables, the vapor pressure of water at 60 deg. F. is 0.5217 in. Hg or 0.256 lb. per square inch. From the slide rule, the molecular weight of water is 18 and the molecular weight corresponding to 0.6 specific gravity gas is 17. Then substituting in the equation:

$$\frac{0.256 \times 18}{(600 - .256) \times 17} = 0.000453 \text{ lb. water vapor per pound of dry gas.}$$

The gas mixture of 120,000,000 cu.ft. per day must be corrected to a dry gas, consequently:

$$\frac{120{,}000{,}000}{24} \times \frac{14.7 - 0.256}{14.7} = 4{,}910{,}000 \text{ cu.ft. of dry gas per hour.}$$

From the rule, 1 cu.ft. of 0.6 specific gravity gas at 60 deg. F. and 14.7 lb. absolute pressure weighs 0.045 lb. Then the weight of the 4,910,000 cu.ft. of gas flowing per hour equals 4,910,000 $\times$ 0.045 = 221,000 lb. of gas per hour. It was found above that 1 lb. of dry gas will pick up 0.000453 lb. of water vapor if saturated, therefore, the quantity of water vapor that will be picked up per hour will be $\frac{221{,}000 \times 0.000453}{8.33} = 12$ gal.

When the chemical formula (and hence the molecular weight) of a gas is known, the rule may be used to obtain the various gas properties necessary in ordinary calculations. However, where extreme accuracy is required, the supercompressibility of the gas, or deviation from Boyle's Law, should be taken into account, as the rule does not correct for this factor. Gases are subject to

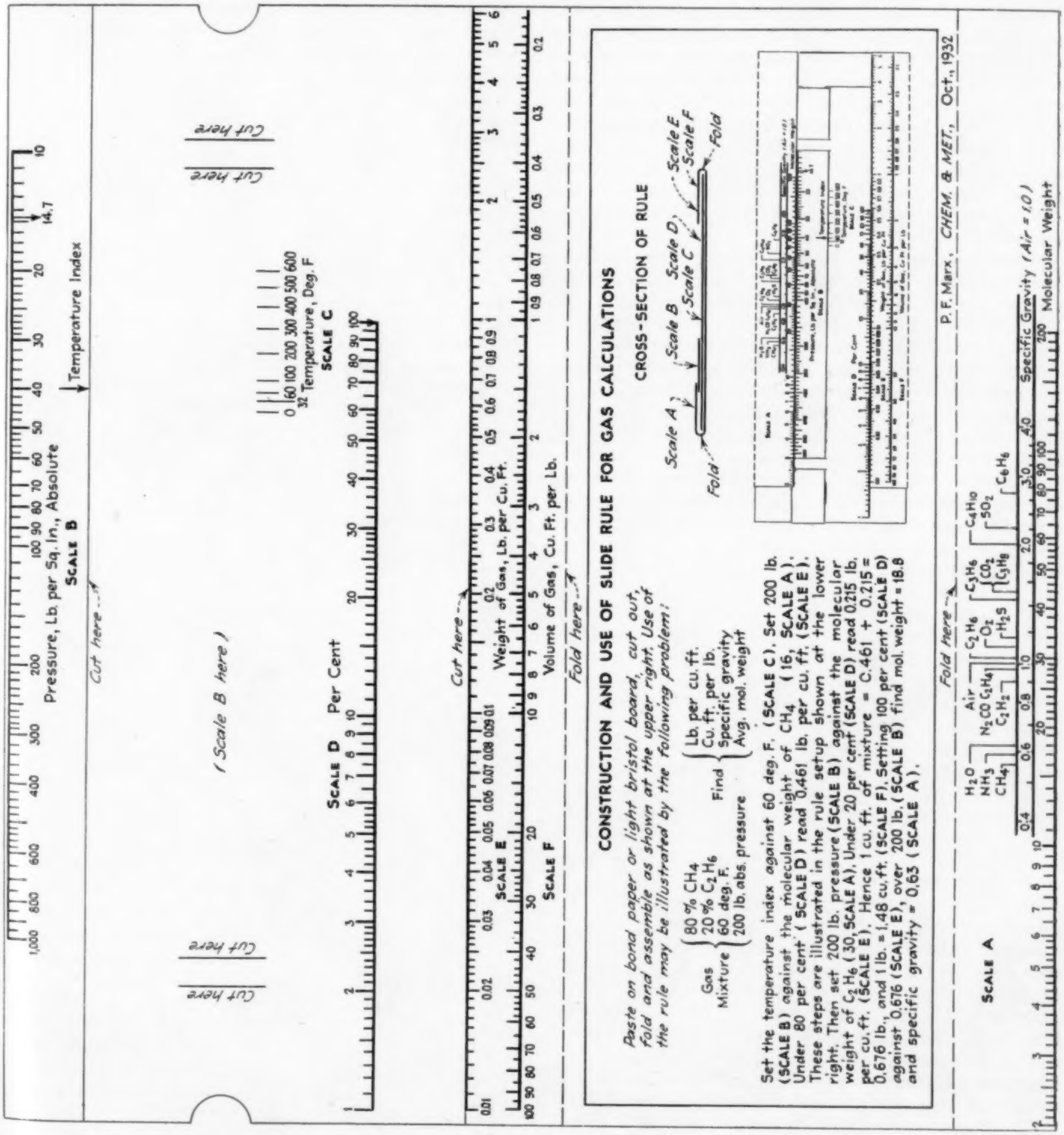
various degrees of supercompressibility. Most gases have a positive correction, while some gases such as hydrogen, have a negative correction. It has been determined that the heavier the hydrocarbon, the greater its compressibility factor. At the present time, this factor can be obtained accurately only by actual test, although a general formula disregarding temperature may be used. This formula is:

$$\text{Per cent deviation} = 0.155p\,\frac{(m + 4e + 8r + 3c + 0.22a)}{1{,}000}$$

where p = gage pressure, pounds per square inch; m = percentage of methane; e = percentage of ethane; r = percentage of propane; c = percentage of carbon dioxide; and a = percentage of air in the gas.

The deviation given by this equation is the percentage decrease in from the theoretical gas volume given by Boyle's Law when the gas is compressed from atmospheric to some pressure, p. Obviously, the volume-weight relations of the gas change proportionately.

By tracing the rule shown below and cutting out the separate pieces it is possible to make a complete rule as illustrated. This rule is readily applicable to various problems and the engineer will find that its use will greatly simplify tedious calculations.



Safety Has New Significance In Chemical Industries

EDITORIAL STAFF REPORT

MIXED TRENDS are evident in recent accident statistics for chemical industry. There has been a marked increase in severity rates, rising steadily from 1.63 in 1929 to 1.84 in 1931—a gain of 13 per cent. Yet during the same period there has been a much larger decrease (36 per cent) in the frequency of lost-time accidents. Ira V. Kepner, in his report as chairman of the statistics committee of the chemical section of the National Safety Council, cited these figures in the opening session of the 21st Safety Congress in Washington, Oct. 4. The paper, presented by C. E. Ralston of the Pittsburgh Plate Glass Co., attributed the situation in part to the psychological influences of the depression which are more favorable to the elimination of temporary disabilities than of more serious injuries.

Ability to eliminate all types of injuries is strikingly demonstrated in the records of a number of individual plants. Thus the cellulose products division of the Hercules Powder Co. had records of over 1,500,000 continuous man-hours without a lost-time accident. A company producing pharmaceuticals and fine chemicals reported 852,000 man-hours, and was followed closely by a large acid plant with 838,000 hours. The Fremont, Ohio, plant of the National Carbon Co., worked 606,000 man-hours without a lost-time injury.

Warren N. Watson, secretary of the Manufacturing Chemists' Association, discussed the safe handling of chemicals, primarily for the protection of the ultimate consumer. Such products as medicinals, cleaning preparations and insecticides represent only a small fraction of the industry's total output but one in which the manufacturer has a disproportionately large responsibility. Mr. Watson listed the following means available for safeguarding the ultimate consumer: (1) Symbols; (2) Poison labels; (3) Characterization by color, odor or taste; (4) Special regulatory agencies and (5) Informative and Precautionary Instructions.

Probably the most effective of the symbols is the skull and cross-bones on poisonous articles but Mr. Watson warned that the indiscriminate extension of its use to relatively harmless products is bound to result in public indifference and thus destroy its great warning value. It is hoped that equally effective symbols may be developed for "flammables" and "volatiles."

Franklin R. Fetherston, secretary-treasurer of the Compressed Gas Manufacturers' Association, presented a comprehensive summary of safe practices in the storage and handling of compressed gases and volatile liquids, i.e., those commodities having vapor pressures exceeding 25 lb. per square inch at 70 deg. F. The fact that during 1931 compressed gases were responsible for only $65 in damage on all the railroads of the United States and Canada is especially significant when it is considered that the gas industry owns approximately 5,000,000 gas containers which are kept in constant circulation. However, Mr. Fetherston warned strongly against their misuse or failure to observe the very simple precautions that have been widely promulgated by his association and in the Safe Practice Pamphlets of the National Safety Council.

A chemical engineering attack on the efficiency of modern respirator filtering mediums to lead dust and fume was reported by Ruel C. Stratton, supervising chemical engineer of the Travelers Insurance Co. His study, which included the testing of 20 or more types of material, lead to the conclusion that, for obtaining a filtering efficiency greater than 70 per cent, a closely matted felt, a close-fibered filter paper or a material of similar character is required.

Meeting Oct. 5 in joint session with the Industrial Health section, members of the chemical section participated in a symposium on poison prevention in chemical industries as presented from the viewpoints of the chemical manufacturer and the state and federal governments. F. W. Dennis, personnel director of the Hooker Electrochemical Co., clearly stated the case for the industry when he demanded more harmonious and intelligent cooperation on the part of the chemist, the engineer, the doctor, the toxicologist, and the state and federal agencies. He cited specific examples where a certain chlorinated compound had been barred from nitrocellulose specifications of the U. S. Navy because of an adverse report by a toxicologist who had never seen, smelled or tested this particular chemical. Another case was one of ignorance of a family physician who accepted a diagnosis of "chemical poisoning" for a chemical plant employee without any attempt to investigate the conditions of employment. All such incidents prove costly to the manufacturer without in any way advancing the cause of prevention.

W. P. Yant, supervising engineer at the Pittsburgh Experiment Station of the Bureau of Mines, gave a lucid description of what the federal government is doing to enhance safety in industry. At least six of the ten departments and one independent agency are specifically charged by law with the promotion of industrial health matters. In all there are no less than eleven governmental bureaus engaged in one phase or another of this work.

Dr. Albert S. Gray, director of the bureau of occupational diseases in Connecticut, spoke from the viewpoint of the state, emphasizing particularly the work of his bureau on the problems involved in the lead industries, in chromium plating, in the use of carbon tetrachloride and trichlorethylene in dry cleaning and in the dust hazards resulting from sandblasting.

From an engineering standpoint, most interest in the chemical sessions centered in the Thursday morning meeting when James T. Lawrence, chemical engineer, E. I. du Pont de Nemours & Co., discussed safety in chemical pumps and pumping machinery, while Karl E. Luger and E. C. Wright, metallurgists with the American Sheet & Tin Plate Co. and the National Tube Co., respectively, presented a summary of the use of stainless steel in the chemical industry.

J. K. Hoskins, sanitary engineer of the U. S. Public Health Service in charge of stream pollution investigations at Cincinnati, discussed some of its causes and effects. The meeting was concluded with a round-table discussion of the types of accidents commonly encountered in chemical industry.

Better Cake Washing on Continuous Filters

By GEORGE W. O'KEEFFE

Arthur Wright and Associates
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IT IS fundamental to the method of cake washing on continuous filters that the wash water, percolating through the cake, displaces the strong liquor. This is in contrast with the scheme of lowering the gravity by dilution as is the practice in countercurrent decantation methods. Furthermore, the opportunity for obtaining a displacement wash of the cake is far greater with continuous filters than in plate-and-frame filter presses. In these units the deposited cake is seldom uniformly resistant and when washing is through the frames from alternate plates, this unequal resistance to flow is accentuated.

Theoretically, there is a better opportunity for true displacement wash in pressure- or vacuum-leaf filters, for the cakes are submerged in the wash water so that every square inch of cake surface is completely wetted. Practically, the pressure-leaf filters can obtain a displacement only in proportion to the personal efficiency of the operator. If he fails to shut off the filtering or loading cycle before the adjacent cakes touch each other, he creates unequal resistance to the passage of the wash water and depreciates the efficiency of his cake washing. If he fails to hold enough pressure in the filter while draining back the unfiltered slurry, he will sluff off some of the deposited cake and his washing efficiency is lost. If he uses too high a pressure in draining the excess, he endangers his washing efficiency by dewatering the upper part of the cake even to the point of cracking the cake.

Continuous filters suffer none of these drawbacks provided the point of application of the wash water is correct. To delay the application until cake shrinkage has set in fails in correctly applying the wash water. Failure to supply sufficient water so that the cake is partly dewatered during the washing cycle is likewise erroneous.

There are instances of materials filterable on continuous filters that present so high a resistance to the percolation of wash water that the restricted washing time possible does not provide for sufficient passage of water through the cake. Some of the organic compounds, greasy or waxy in character, some of the weak-structured chemical precipitates, and some of the amorphous compounds are typical of this class of products. Continuous filters applied to this class of work should operate in a countercurrent wash system, repulping the cake from one filter and refiltering it on a succeeding filter.

For this discussion we shall limit ourselves to those materials that filter readily and tend to form cakes which crack readily on dewatering or are of a granular nature. Typical examples of the former include: high-grade residue containing complex iron and aluminum compounds from phosphate plants; barium carbonate or sulphate; and crude lithopone. Examples of the latter are: calcium carbonate or sulphate; stearates of aluminum; and certain resinates.

With the cracking type of cake most of the wash water goes through the cracks and high wash-water consumption with inadequate removal of soluble materials results. A special washing and compressing belt has been used with excellent results in overcoming this difficulty. Cake compression is vitally important in this operation as it densifies the cake and gives more uniform stream lines for the displacement wash.

In a phosphate plant the high-grade residue has been washed better than with presses, and using far less wash water. Considering that the Baumé of the liquor handled ranges from 30 to 40 deg., the results are excellent. In washing such a cake the wash-water consumption varies from 7 to 9 lb. of wash water per pound of dry cake.

Granular cakes present a slightly different problem. With such a cake the percolation of wash water is very rapid. To obtain uniform wash under these conditions is far from easy. With the quantity of wash water required, it is impossible to prevent guttering of the cake in a manner similar to that obtained in crack-forming cakes. Again the wash belt lends itself admirably to the washing. On such types the quantity of wash water is usually less. Liquor of 7 deg. Bé. has been washed to 0.1 per cent soluble in the cake with from 3 to 5 lb. of wash water per pound of dry cake.

For material more restrictive to the flow of wash water or requiring the least possible soluble matter left in the cake, the countercurrent, two-filter wash is used with repulping between the filters. This system is especially attractive where it is desirable to keep up the Baumé of the vented liquor. In this case it is customary to fractionate the liquors from the last filter. The stronger or first liquor fraction is used as a wash on the first machine and the second or weaker fraction is used to repulp the cake from the first filter. Fresh water is used, of course, on the final filter. Wash-water consumption with this type of material and on such a filter layout usually runs from 2 to 3 lb. of water per pound of dry cake.

There are also certain classes of precipitates that absorb or occlude the mother liquor. Such materials require special handling to make the soluble matter available. Subjecting the repulped cake to vigorous agitation decreases the particle size and makes it possible to remove the soluble by displacement washing. Numerous filtrations and repulpings do not appreciably lower the soluble matter in such precipitates. Only proper physical treatment of the discharged cake will insure satisfactory washing.

Comparative tests have been run with and without the belt and it has been shown that the belt makes it possible to wash effectively with the same quantity of wash water, even when half the soluble is left in the cake. The cake is also considerably drier and the vacuum pump requirements less by many cubic feet of pump displacement.

In conclusion, the writer has proved that continuous filters equipped with wash belts can handle many of the products which in the past have not been efficiently washed on automatic filters. His recent experience indicates an increasing field for the application of continuous filters in obtaining better washing efficiency than was possible with previously used filters of the intermittent type.

Hydraulic Head in the Solution Of Pumping Problems

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With pumps used for such diverse purposes as irrigation, boiler feeding, brine circulation, condenser cooling-water circulation, acid and process liquor handling, and oil pipe-line service, it is not surprising that there is some confusion in the terms used in referring to pump performance. There are, however, underlying principles which apply to all cases, serving to explain not only the usual pumping conditions but also the special and more complicated cases.

A grasp of the fundamentals of any pumping system demands first an understanding of Bernoulli's theorem which states that the total energy of any fluid as it passes in continuous flow from point to point in a system remains constant, provided that the fluid does no work, and has no work done on it. Thus, neglecting friction and providing that there is no pump between two points in a pipe, the total energy of water flowing through the pipe remains unchanged from the first to the second point.

Energy of a fluid, in English units, is expressed in foot-pounds per pound, or by the more common term, "feet head." The total energy of any pound of fluid is not an absolute quantity but depends in part on arbitrary standards. For example, the energy consists of three components, or heads, of which the first is the potential energy of elevation of the pound of fluid above (or below) some reference plane which may be taken at any suitable location such as sea level or the level of the storage reservoir. The second component is the pressure energy of the fluid; and the third, the velocity energy which exists by reason of the flow. Mathematically expressed, the total energy of 1 lb. of fluid at some point (1) is

$$Z_1 + P_1 + (V_1)^2/2g$$

where Z_1 is the elevation of the point in feet above (or below) the reference plane; P_1 is the pressure registered by a gage calibrated in feet of the fluid being handled; and the last term, $(V_1)^2/2g$, which is the kinetic energy or velocity head, is composed of V_1, the mean velocity of the fluid at the point in feet per second, and g, the acceleration of gravity, 32.2 ft. per second per second. The total head at point (1), therefore, is the sum of the elevation, pressure and velocity heads at the point. The pressure head, which is ordinarily measured in pounds per square inch, must of course be expressed in terms of the height of column of fluid which would exert this pressure and must be corrected for the density of the fluid at the operating temperature. With water, for example, the equivalent of a pressure of 1 lb. per square inch is 2.3067 ft. at 4 deg. C. and 2.4069 at 100 deg. C. The value taken for ordinary temperatures is generally 2.31 ft.

By Bernoulli's theorem, then, the total energy at the two points, (1) and (2), may be equated and

$$Z_1 + P_1 + (V_1)^2/2g = Z_2 + P_2 + (V_2)^2/2g.$$

The components at the two points will differ when there is any change in diameter of the conduit or in the elevation, but the total in a frictionless system remains unchanged. In a practical system the energy decreases due to friction as the flow proceeds; and the energy at point (2) will be equal to that at point (1) minus the friction loss. Insertion of a pump between the two points will increase the energy, for a pump is simply a machine for adding hydraulic energy.

In Fig. 1 an elementary pumping system is shown. The pump is stationary and the system is considered at the instant the valve is opened. The tank at the left is the supply reservoir; the one at the right, the discharge. The surface of the water in the discharge tank is at elevation Z_d ft.; the level of the suction supply is at Z_s ft. Any pound of water in the discharge tank can be shown to have a total energy of Z_d ft.-lb. Some of the pounds are below the surface and do not have Z_d ft.-lb. of *elevation* energy, but the difference is made up by *pressure* energy. In the same manner the energy of any pound of water in the suction reservoir is Z_s ft.-lb.

The total static head for any pumping system is the total energy at the discharge minus the total energy at the suction. The total static head in Fig. 1, therefore, is $(Z_d - Z_s)$ ft., the vertical difference between the suction and discharge levels. If pumping systems were all as simple as this one, the rule in the first sentence of the paragraph would be of importance to theorists only. However, the rule has a very pointed practical use in the cases of many systems such as boiler feed, condensate, and fire systems, in which cases the difference in suction and discharge elevations is only a part of the story.

There are also two other heads which may be defined in the system of Fig. 1. The energy head of the suction supply, minus the elevation of the center of the pump, is the static suction head. Although in some cases the suction energy may be a compound of elevation and

pressure, it should be noted that the figure we subtract from it to obtain static suction head in the *elevation* only of the pump center. In the figure, the suction energy Z_s ft., happens to be greater than the elevation of the pump center, Z_p ft., and the static suction head is positive. When the suction level is below the pump, the subtraction produces a negative result. It is common to refer to negative static suction heads as static suction "lifts."

In like manner, the static discharge head is the energy of the discharge minus the elevation of the pump center, or $(Z_d—Z_p)$ ft. Most static discharge heads are positive, but they are not necessarily so. Negative discharge heads are often encountered in drainage pumping.

Gage Versus Absolute Heads

In the foregoing, the effect of atmospheric pressure was neglected. The heads obtained, consequently, were "gage" heads. It is permissible to deal in gage heads wherever the discharge and the suction are both subject to atmospheric pressure. But if the air pressure had been added to the suction and discharge elevations to give absolute heads, the rules would have held nevertheless. Total static head is neither gage nor absolute since it is a *difference,* but static suction and discharge heads, being referred to a constant elevation, are absolute heads under these circumstances. Ordinarily, when no mention is made of gage or absolute, it is the former that is meant in pumping literature. A suction lift, that is, a negative suction head, is always gage, since there can be no negative absolute suction head in a successful system.

In the consideration of Fig. 1 the pump was not operating and static conditions were assumed. Now suppose the pump to be started up as in Fig. 2. Examining for the moment only the suction side we find that the liquid loses energy as it passes from the suction well to the pump because of friction in the piping. At the pump the head of the liquid is $(Z_s—f_s)$ ft., f_s being the friction loss of the suction system. The "dynamic suction head" is always the static suction head minus the friction loss of the suction system. In the figure, it is $Z_s—Z_p—f_s$. This rule holds no matter where the pump is located with respect to the suction supply. Assume a suction level at elevation 10 ft., a pump the center of which is at elevation 15 ft., and a suction-system friction loss of 5 ft. The dynamic suction head (gage) is then (10—15—5) ft. = —10 ft., which is expressed another way by saying that the dynamic suction lift is 10 ft. The same rule applies also to absolute heads, although the answers will always be positive.

Those who prefer to deal in suction lifts should note that friction loss is subtracted from static suction heads (gage) but added to static suction lifts to give dynamic suction conditions.

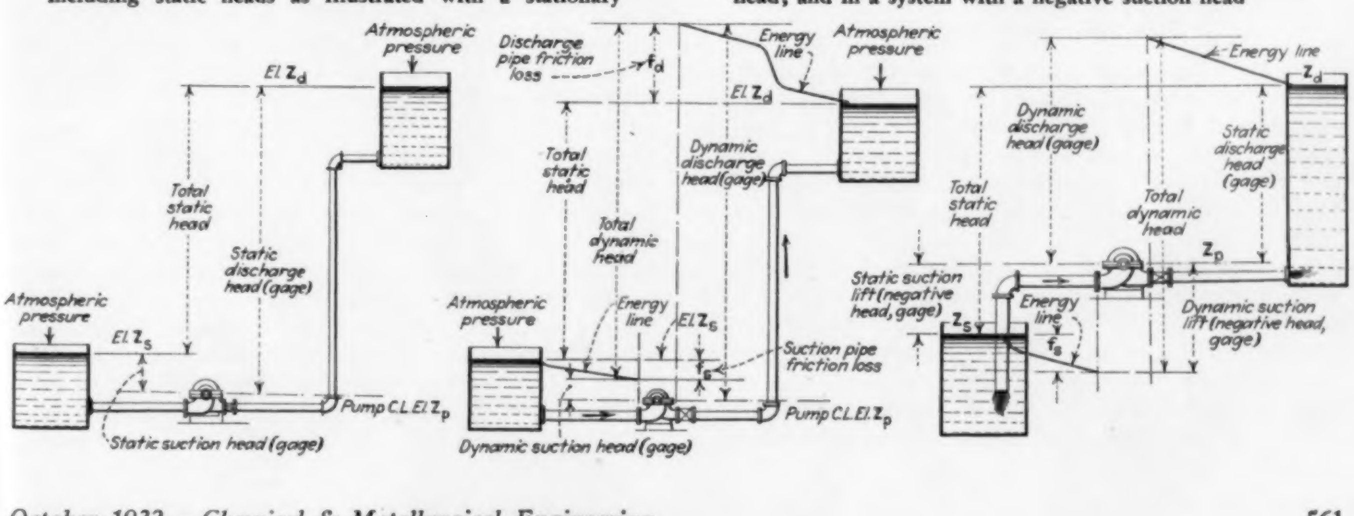
Now if the discharge side of the system in Fig. 2 be considered, it will be seen that the total energy of the fluid decreases because of friction as the flow passes from the pump to the discharge. The "dynamic discharge head" is always the static discharge head plus the friction loss of the discharge system. This holds whether the static discharge head is positive or negative. For instance, imagine an oil pipe line discharging down hill with a static discharge head (gage) of —50 ft., and a friction loss of 1,000 ft. The dynamic discharge head is, therefore, —50 + 1,000 = + 950 ft. gage.

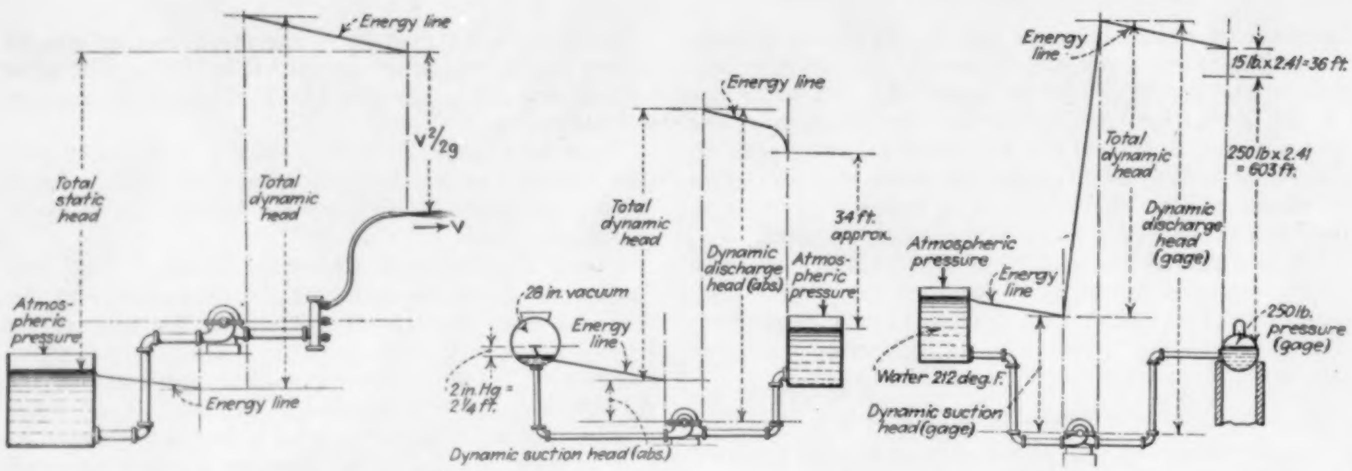
Considering the suction and discharge sides together in Fig. 2, we note that the "total dynamic head" equals the dynamic discharge head minus the dynamic suction head, which is always the case. Of course, both heads must be on the same basis, either both gage or both absolute. Furthermore, the subtraction must be algebraic; for instance, if the dynamic discharge head is 100 ft. and the dynamic suction head is —10 ft. (*i. e.,* dynamic suction lift is 10 ft.) the total dynamic head is 100—(—10=110 ft. In Fig. 3 the various heads are shown for a system with a suction lift.

Total Dynamic Head Measures Performance

It should be noted that total dynamic head, like total static head, is a difference of heads and is, therefore, neither gage nor absolute. Total dynamic head is also equal to the total energy of the fluid at the *discharge nozzle* of the pump, minus the total energy at the *suction nozzle*. It follows, therefore, that the total dynamic head is the head that governs pump performance. This is, of course, reasonable since the pump is not responsible for the friction loss of the suction and discharge systems. The terms "water horsepower" and "brake horsepower," as encountered in pumping, are both based upon total dynamic head. Water horsepower is the rate of doing work on the fluid pumped and is found by dividing the

Figs. 1, 2 and 3, Left to Right—Heads in various set-ups, including static heads as illustrated with a stationary pump; dynamic heads in a system with a positive suction head; and in a system with a negative suction head





Figs. 4, 5 and 6, Left to Right—Heads in special cases, illustrated by a fire stream; a system with a suction under vacuum and an atmospheric discharge; and a system with an atmospheric hot-water feed to a boiler under pressure

rate of flow in pounds per minute by 33,000 (or by dividing gallons per minute by 3,960 in the case of water) and multiplying the result by the total dynamic head. Brake horsepower is the power required at the pump shaft to produce the desired result in water horsepower and is equal to water horsepower divided by the pump efficiency.

Hitherto, only the simplest pumping systems have been considered, although the statements made applied to all systems, no matter how complicated. It remains to examine some of those that are more involved to see how the elementary principles apply.

In all the earlier examples the systems discharged under water. This was done to eliminate premature confusion about the energy at the discharge. But many pumping systems do not discharge under water as, for example, in the case of an open pipe discharging above a tank. The question arises: what is the energy of the discharge? Is it the elevation of the water level in the discharge reservoir; or is it the energy of the fluid as it leaves the discharge pipe? Obviously, it must be the latter since the level of the fluid in the discharge reservoir can have no effect on the work to be done by the pump. In problems of this sort, the energy of the fluid leaving the discharge pipe is taken equal to the elevation of the center of the nozzle (for gage heads), the velocity head being neglected. This is because the velocity head is quickly dissipated and serves no useful purpose.

Fire Streams a Special Case

There are important exceptions to the case described in the last paragraph, however. In Fig. 4 a system including a fire stream is shown. In such a case discharge velocity cannot be dismissed, for such velocity is one of the prime reasons for the system. Here the head at the discharge should be taken as the elevation of the nozzle plus the velocity head for gage heads, or this figure plus atmospheric pressure for absolute heads. The solution for gage heads is illustrated in Fig. 4. In practice, it is much easier to use empirical tables for fire streams, such as those compiled by Freeman. His tables give pressures necessary both at the nozzle and at the hydrant, for various lengths of standard fire hose, to produce streams of various characteristics. For instance, the tables show that 75 lb. per square inch pressure at the hydrant will maintain a stream discharging 228 g.p.m. through a 1-in. smooth nozzle a vertical distance of 79 ft. when the nozzle is connected to the hydrant by the 100 ft. of 2½-in. smooth rubber hose. In this case, the discharge energy can be set down as the elevation of the hydrant plus 75 x 2.31 ft. This figure minus the elevation of the pump center approximates the static discharge head. The term "approximates" is used because friction in the hose and nozzle is included in the result. When obtaining the dynamic discharge head from this figure, friction from the pump to the hydrant, only, should be added.

Even if the static discharge head were calculated from the elevation of the nozzle and the velocity head at the nozzle, it would be found to vary with the capacity flowing because of the velocity component. In all previous cases discussed, static heads were independent of flow.

Absolute Heads Simplify Certain Problems

It has been pointed out that total heads, both static and dynamic, are differences and are, therefore, neither gage nor absolute. It is essential that the heads at both sides of the pump be on the same basis before subtracting to obtain these differences, however. In Fig. 5 is illustrated a type of problem which is less confusing when dealt with in terms of absolute heads, because gage pressure does not exist over the suction well. Here a condensate pump unwaters a condenser operating at 28 in. vacuum (referred to a 30-in. barometer) and discharges the condensate into an open heater. The absolute pressure of 2 in. Hg (since 30 in. Hg is roughly equivalent to 34 ft. of water) amounts to an absolute pressure of 2¼ ft. of water. The total energy of the water in the condenser well is the elevation of the surface plus 2¼ ft. This total minus the elevation of the pump center is the absolute static suction head. The absolute static suction head minus the friction of the suction system equals the absolute dynamic suction head. On the discharge side, the energy of the water in the heater should be taken as the elevation of the water surface plus 34 ft. The absolute static discharge head is the elevation of the heater level, plus 34 ft., minus the elevation of the pump center. The absolute dynamic discharge

head equals the absolute static discharge head plus the friction of the discharge system. Total dynamic head is determined by subtracting the absolute dynamic suction head from the absolute dynamic discharge head.

In Fig. 6 is illustrated a boiler feed system in which a pump draws water from a heater and discharges to a boiler. Where the heater is open, or exposed to atmospheric pressure, and the boiler pressure is given in pounds gage, it is not necessary to deal in absolute heads. The discharge energy is the elevation of the water in the boiler, plus the boiler pressure in feet of water, plus a differential pressure to insure easy entrance of the water into the boiler and to permit regulation. In practice, this differential pressure is taken up in friction through a partially closed admission valve. The total static head is the total energy of the discharge minus the elevation of the water in the open heater, provided the boiler pressure is expressed in gage figures. The total dynamic head is the total static head plus all friction.

Head-Pressure Relation Depends on Temperature

Due attention should be paid to the liquid temperature in boiler feed and similar problems. Water at 212 deg. F., gives a head of 2.41 ft. per pound pressure per square inch. A boiler pressure of 250 lb. corresponds, therefore, to 603 ft. of water when the water temperature is 212 deg.—not 578 ft., which would be correct for cold water. Since the principle of operation of a centrifugal pump is such that it produces a certain definite head in *feet* from a certain speed of operation, no matter whether the density of the fluid is 0.5 or 5.0, this is a very important point when dealing with this type of boiler feeder, and becomes more so, the hotter the water.

Having corrected the feet head for the temperature, it then becomes necessary to correct the horsepower to the cold water basis by multiplying it by the density of water at 212 deg. F., or 0.96. Of course, in such a case, the pump motor should be of sufficient power to handle the cold-water head and the cold-water density in the event of any suspension of feed-water heating.

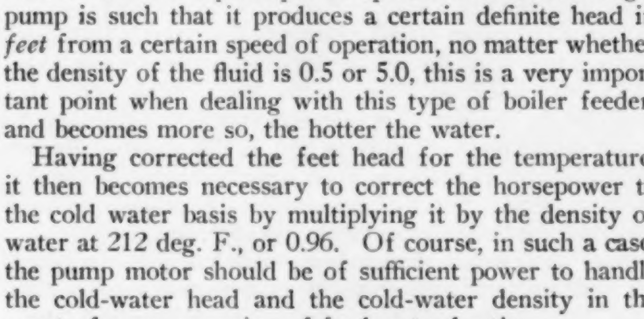
The foregoing illustrations are typical of the calculations necessary before a pump is installed. After installation has been completed and operation has started, the total dynamic head can be determined directly by gage readings at the pump. Assume that a pump receives water at pressure, P_s, and velocity, V_s, discharging it at pressure, P_d, and velocity, V_d. The elevation of the center of the suction nozzle is Z_s; and of the discharge nozzle, Z_d. Whether pressures are both expressed in gage figures or in absolute figures, the algebraic subtraction of $Z_s + P_s + (V_s)^2/2g$ from $Z_d + P_d + (V_d)^2/2g$ will give the total dynamic head. In practice, the gages used to read suction and discharge pressures are corrected to read pressure at the pump center. Therefore, the elevation heads Z_s and Z_d, cancel out, leaving the following expression:

$$\text{Total dynamic head} = P_d - P_s + \frac{(V_d)^2 - (V_s)^2}{2g}$$

In order to determine total head accurately by gages, the capacity flowing must be known in order to make the correction for difference in velocity heads for the suction and discharge nozzles. Of course, if both nozzles are of the same size, no such correction is necessary since the velocity heads cancel out. In most cases, however, the discharge nozzle is of smaller diameter than the suction, resulting in a correction to be added to the gage difference. The capacity flowing can be determined by various methods such as Venturi tubes, weirs and pitot tubes.

One method of attaching gages is illustrated in Fig. 7. Discharge pressure, whenever it is more than several feet, is usually measured by a bourdon gage which indicates pressure at the gage center. Therefore, if the gage is above (or below) the center of the pump, the vertical displacement should be added to (or subtracted from) the gage reading to obtain the true pressure at the elevation of the pump center.

Fig. 7—Gage connections and corrections for determining dynamic head in an operating system



Correcting Mercury Manometer Readings

Similarly, when a mercury manometer is used to measure the suction pressure, correction must be made to give the true reading at the pump center. The connecting tube will be filled with water and the gage measurement will be the pressure at the "wet" end of the mercury column. The unbalanced height of the mercury is converted into equivalent feet of water and this head (which may be either positive or negative) is then corrected for the vertical distance from the mercury-water contact to the pump center as in the case of the bourdon gage. Since this correction will have to be made separately for each different reading, a more convenient method is to make a single correction, once and for all, for the distance to the center of the unbalanced mercury column (**C_s** in Fig. 7). Then each individual reading must be further corrected for half of P_s, the unbalanced mercury column (measured in feet, *not* in equivalent feet of water), so that the net result will be a correction of $C_s - \frac{1}{2}P_s$, or the distance from the mercury-water contact to the pump center. The proper signs for the corrections may seem somewhat confusing, but are readily determined by making a sketch of the particular set-up and adding or subtracting so as to give the true static reading corrected to the pump center.

Editor's Note: Readers who were interested in the methods for evaluating friction loss in piping systems as outlined in the earlier paper by Messrs. Reed and Morrison (*Chem. & Met.*, Aug., 1932) will profit from the study of a number of graphical methods for the solution of special problems in pipe flow which have been developed by Grant K. Palsgrove, professor of hydraulic engineering at Rensselaer Polytechnic Institute. These are outlined in the Institute's new Bulletin 37 of the Engineering and Science Series.

Twelfth Fall Weld Meeting Convenes in Buffalo

DURING the week of October 3, the American Welding Society met for its annual fall convention in Buffalo. The sessions covered a broad field of interest and included two symposiums, one on fundamental research in welding, the other on the merchandising of welding. A welding exposition was held.

Among the papers of direct interest to chemical engineers was one on lead "burning," presented by Robert L. Ziegfeld of the Lead Industries Association. Autogenous welding of lead was once an hereditary art but is now taught in some trade schools. The author outlined methods for producing various sorts of joints and stated that the average man can learn to do a fair job in about two weeks. The oxy-hydrogen flame, according to the paper, is still preferred by the vast majority of expert lead burners.

Four papers were presented in the symposium on fundamental research. The first of these concerned the X-ray determination of stresses in welds and was presented by John T. Norton, Massachusetts Institute of Technology. He concluded that X-ray photograms cannot be used in the direct deduction of stresses in a metal sample, but that they supply very definite information about the amount of plastic deformation which individual grains have received and show the extent to which this damage may be repaired by recrystallization. In the second of the symposium papers, Gilbert E. Doan and J. Murray Weed, respectively of Lehigh University and the General Electric Co., discussed metal deposition in electric arc welding. They found that with uncoated or lightly coated electrodes, liquid globules are the chief form of metal transfer and believe that the same is true when the longer arc possible with the coated electrode is used.

The effect of simultaneous corrosion and alternating stresses in welded specimens was investigated by Wilbur E. Harvey and F. Jerome Whitney, Jr., of Lehigh University, who reported their investigations in a paper on the corrosion fatigue of low-carbon steel. As the authors point out, corrosion fatigue appears not to depend upon the mechanical properties of the metal but rather upon changes in the electrolytic solution pressure, resulting from increase in the stress. Investigations previously made by D. J. McAdam, Jr., have shown that the corrosion-fatigue limit for steels other than those of the stainless variety never exceeds 25,000 lb. per square inch. This result was confirmed with welded specimens which were subjected to rotating stresses in the presence of a carbonate tap water. The material was fire-box quality steel, and the welding methods tested included covered-wire arc welding, bare-wire arc welding, atomic hydrogen welding, gas welding and electric resistance welding. It was concluded that the effect of welding upon the corrosion-fatigue limit of a low-carbon steel is not deleterious except in the case of bare-wire arc-welded specimens. In this case, however, it was recognized that the welds were poor, and that with better welding, the corrosion-fatigue limit might be raised. Grain size, as was expected, seems to have no effect on the corrosion-fatigue limit of welded materials.

Distribution of stresses in welded double butt-strap joints was examined by S. C. Hollister and A. S. Gellman, both of Purdue University. Using samples made with various sorts of joints, the authors set up extensometers and measured the stresses under tension, plotting the results at various cross-sections. They concluded that splices using closed-contour welds show better distribution of stress throughout the entire splice. It also appears that transverse and side welds, when used in the same joint, participate to about the same extent in transferring the load. Diamond-shaped splices show the best distribution of stresses in all elements of the connection and may be considered the most suitable type for many purposes.

Discussing the chemistry of low-carbon, metal-arc weld metals, J. C. Hodge, the Babcock & Wilcox Co., gave analyses of metal deposited from the metal arc under various conditions of protection. He found that the nitrogen content of metal-arc weld metals may vary from 0.015 to 0.15 per cent, depending on the degree of protection afforded by the electrode coating or artificially produced atmosphere surrounding the arc. Although oxygen determinations were not made in the investigation, it is also presumed that oxygen content increases with decreasing protection. Carbon and manganese are considerably lowered with decrease in the protection of the arc.

Use of sprayed metal coatings, both for building up worn parts and for protection against corrosion, was described by H. B. Rice, of the Metal Spray Co. He outlined the development of metal spraying equipment as it has taken place in Europe and in this country during the last 20 years and described some of the recent equipment in detail. Successful examples of reclamation have included the building up of almost all types of shaftings, sleeves and liners, from 1 in. to 15 in. in diameter. The interior surfaces of pump casings and valve bodies have been protected with sprayed lead, stainless steel, Monel and other metals. Chrome steels have been used in petroleum refineries in fittings and connections handling hot oil. Sprayed linings have been applied in bubble towers and reaction chambers. The worn inside areas of several compressor cylinders have been built up with sprayed metal and machined to size. Blowers handling acid vapors have been successfully coated by this process. The interiors of acid tanks have been protected by sprayed lead, and have been found quite satisfactory after several months of operation.

P. R. Hawthorne, Struthers-Wells Co., described some of the recent developments in heavy electric-arc welded equipment for pressure uses. He stressed the need for a high quality of work in Class 2 welding (as defined by the new A.S.M.E. Code for fusion-welded vessels), expressing the belief that all equipment manufacturers should be prepared to do Class 1 welding and that some of the safeguards required for Class 1 could profitably be applied to Class 2. Another paper from the Struthers-Wells Co. was that of J. C. Holmberg, metallurgist, who explained the effect of atmosphere in welding and showed how the use of heavy-coated electrodes improves the quality of welding. He also outlined a theory to explain the locking-up of stresses in welds and emphasized the desirability of stress relieving.

BOOKSHELF

Alexander's Colloid Chemistry

COLLOID CHEMISTRY, THEORETICAL AND APPLIED, Vol. IV. Edited by *Jerome Alexander.* Chemical Catalog Co., New York. 734 pages. Price, $11.50.

Reviewed by *Per K. Frolich*

THIS FOURTH and last volume of Alexander's compilation of papers deals with the general subject of colloid chemistry and its application. The first volume, which appeared in 1926, was devoted entirely to topics of a more or less theoretical nature, serving thereby to lay the foundation for subsequent discussions of specific subjects. In the second volume, published in 1928, the trend was toward the colloidal aspects of biology and medicine.

Like the third volume (1931), the present one is made up chiefly of papers on technological aspects. The book contains a total of 42 chapters dealing with a variety of subjects such as carbohydrates and their industrial processing; the dyeing of textiles and various phases of the rubber industry; tanning and photography; resins, paints, varnishes and lacquers; bakery products, butter and beer, as well as other miscellaneous items, contributed by individuals of whose interest in the specific subjects proof is to be found in the periodic literature in this country and abroad. The presentations differ greatly in character, ranging from brief statements of personal viewpoints to carefully selected bibliographies. In spite of the general heterogeneity, however, one is left with the impression that the arithmetic mean is distinctly above the average as far as colloidal texts go.

There may be some question as to the wisdom of the Editor's "special effort to secure papers from the representatives of as many nations and nationalities as possible." Clearly, this policy was bound to work out more successfully in the case of the theoretical part than in the technological discussions. For some reason or other it is only in exceptional cases that a writer on a technological subject succeeds in bridging the gap which nearly always exists between the industrial practices of different countries. However, the Editor may argue that it has been his aim to broaden our horizon by making available to us in the English language the thoughts of our foreign colleagues.

Laying aside all personal feelings on the choice of subject matters and authors, the reviewer takes pleasure in concluding this final comment on the series by paying his respects to Mr. Alexander for the enthusiasm with which he has undertaken this compilation and carried it through to completion. The third and fourth volume will be of particular interest to the reader of this magazine, but even the industrially-bent mind can find much of value in the more theoretical chapters.

The Hydrion in Practice

HYDROGEN IONS. Their Determination and Importance in Pure and Industrial Chemistry. By *Hubert T. S. Britton.* Second edition. D. Van Nostrand Co., Inc., New York. 589 pages. Price, $9.

Reviewed by *W. Mansfield Clark*

THE FIRST fifteen chapters deal with the theoretical principles and with the practical means of determining hydrion activity or "concentration." The remaining twenty-two chapters discuss applications with emphasis on several of the many industrial processes which have become in small or large degree dependent upon indicator or electrometric control.

Since the book is one of a series of monographs on "applied chemistry" and is evidently written for the "practical" chemist, it may legitimately avoid, as it does, some of the niceties of concept and expression which would be demanded of a more academic treatise. On the other hand, the fact that industrial chemists are now using extensively the methods which only a few years ago were almost exclusively under theoretical development is proof that theoretical exposition has paved the way to practical application and suggests that the greater benefit of a book of this kind might result from a neat and common-sense exposition of the most modern developments of theory.

The range of the "thermodynamic environment" in industrial processes and in the processes of organic and analytical chemistry is vastly greater than in those class-room experiments which are designed to illustrate the elements of physical chemistry. In their attempts to comprehend the more general relations physical chemists have properly tended to select experimental conditions favorable to the particular principle they wish to investigate with the result that while theory advances much of the systematic compilation of data needed in practice is neglected. It is certainly no fault of Dr. Britton that he has found in the literature comparatively little good systematic work on temperature coefficients but it may be charged that among the few scattered discussions of this matter, which is of great practical importance, he has not very clearly warned the industrialist of the situation, he has neglected to state the temperature at which certain characteristic numbers apply, and he has not been critical.

For the concept of activity Dr. Britton displays a distaste. This is quite proper if the distaste be real because there is no logical compulsion to accept what, in the last analysis, is a convenience. But this hardly removes the obligation to supply the equivalent or at least to make it clear that the electromotive force of a "concentration cell" is a measure of something different from the relative concentrations. A compromise has been made in this second edition by the insertion of a chapter, written by Dr. R. A. Robinson; but this compromise does not provide that unity of exposition which is desirable and the main text leaves the reader with a misleading impression.

Other objections of like nature would only add detail to the impression that the author has not attempted to write for the possible needs of the future but has written for the current demand. In this he has done well. The reader will find here the conventional expositions of the common principles, the devices in use, the essential equations and the more important data all of which are in extensive use. He will also find such a wealth of inspiring information upon practical applications that, if he has not already done so, he will add one or another of the devices to his equipment and further extend what has become one of the most remarkable examples of the practical use of physical chemistry that has occurred in history.

Physical Chemistry of Iron

EINFÜHRUNG IN DIE PHYSIKALISCHE CHEMIE DER EISENHÜTTENPROZESSE. By *Hermann Schenck.* Vol. I: Die chemisch-metallurgischen Reaktionen und ihre Gesetze. Verlag Julius Springer, Berlin. 306 pages. Price, RM 28.50.

Reviewed by *John Johnston*

IT IS INTERESTING to observe the gradual penetration of the idea of applying physico-chemical methods of thinking towards the solution of metal-

lurgical problems. For two or three decades some of these methods have been applied, though not always correctly, to certain types of problem, but in other types of problem little effective use has until recently been made of them. This welcome book should aid in the promulgation of these ideas; it is recommended to any one interested in ferrous metallurgy who will study it. The first third is devoted to a discussion of the principles of chemical equilibrium, that is, of the principles which enable one to predict the limiting extent to which a given metallurgical reaction will go, under specified circumstances, provided the requisite data are known. The remainder brings together the numerical data now available on the properties and behavior of the several components and systems—metallic and non-metallic—which play a part in the processes of ferrous metallurgy.

THE CHOICE OF AN OCCUPATION. Edited by *Albert B. Crawford* and *Stuart H. Clement*. The Department of Personnel Study, Yale University, New Haven. 495 pages. Price, $2, paper; $3, cloth.—In revising this publication, the Department of Personnel Study at Yale University has added considerable new material of a general nature, dealing with principles of vocational selection and self-analysis. The volume now discusses some sixty specific occupations. As was the case with the earlier book of the same title, this edition has been prepared primarily for the use of Yale students, but will be available for general distribution on a limited basis.

Carbohydrates

THE CHEMISTRY OF THE MONOSACCHARIDES AND OF THE POLYSACCHARIDES. By *Hans Pringsheim*. McGraw-Hill Book Company, New York, N. Y. 413 pages. Price, $4.

Reviewed by *Leonard H. Cretcher*

THE VOLUME is based on the lectures delivered by Professor Pringsheim under the George Fisher Baker Non-Resident Lectureship at Cornell University during the Fall Term of 1928-1929. An introductory lecture, "Twenty-Five Years of Biochemistry," precedes the general treatment of carbohydrates. Of necessity sketchy, it nevertheless succeeds in presenting much of the history and spirit of this interesting branch of chemistry.

Part I discusses the general chemistry of the simple sugars, and also contains an interesting chapter on anhydro and amino sugars.

Polysaccharides like maltose and sucrose and many tri- and tetrasaccharides like raffinose and stachyose, which may be obtained in macrocrystalline form, are the subjects of Part II. It is in this field that many of the most important contributions to sugar chemistry have been made in recent years. Nowhere else have these been so comprehensively reviewed.

Approximately two-thirds of the book is devoted to a discussion of polysaccharides of the second order: cellulose, starch, glycogen, dextrines, inulin, hemicelluloses, chitin, etc. In view of the great breadth and complexity of the subject, it is remarkable that so satisfactory a survey of the field could be made so briefly.

The book is largely theoretical, but contains much of practical or suggestive interest to the technologist. It should be especially valuable as a reference book. Chemists and botanists interested in the carbohydrates are to be congratulated in having at their disposal a critical discussion of the subject by one so eminently competent to judge as Professor Pringsheim.

One suggestion to be made is that books which are likely to be used in practical work be bound in some material more resistant to water than the cover of the present volume. A drop of water permanently soils the finish.

REPORT OF THE NATIONAL RESEARCH COUNCIL for the Year July 1, 1930-June 30, 1931. For sale by Superintendent of Documents, Washington, D. C. 92 pages.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

State Requirements for Industrial Lighting, by Marie Correll. Department of Labor, Bulletin of the Women's Bureau No. 94; 10 cents. A handbook for the protection of women workers, showing lighting standards and practices.

Bases of Value for Assessment of Ad Valorem Duties in Foreign Countries. U. S. Tariff Commission Miscellaneous Series, unnumbered; 5 cents.

Preparing Shipments to Canada. by Mary H. Fricker and Henry Chalmers. Bureau of Foreign and Domestic Commerce, Trade Promotion Series No. 91 (Revised).

Third Progress Report on Study of News Ink and Newsprint, by B. L. Wehmhoff and others. U. S. Government Printing Office, Technical Bulletin No. 16.

Prices and Competition Among Peanut Mills. Senate Document No. 132, 72nd Congress, 1st Session. Report of the Federal Trade Commission to the Senate on the peanut industry.

Wood Pulp and Pulpwoods. U. S. Tariff Commission Report No. 43, Second Series. Report to the Senate on the effect of depreciated currency upon imports of wood pulp and pulpwoods.

Surveys of National Petroleum Requirements for Seasonal Periods of 1932-1931-1930. Federal Oil Conservation Board, unnumbered pamphlet; 5 cents.

Standard Samples. Bureau of Standards Circular 398.

Paint for Priming Plaster Surfaces, by Percy H. Walker and E. F. Hickson. Bureau of Standards Miscellaneous Publication 137; 5 cents.

Experiments in Naval Stores Practice, by Lenthall Wyman. Department of Agriculture Technical Bulletin 298.

Control of the Turpentine Borer in the Naval Stores Region, by J. A. Beal. Department of Agriculture Circular 226.

Visual Spectrophotometry of Dyes, by C. W. Holmes and others. Department of Agriculture Technical Bulletin 310.

Critical Laboratory Review of Methods of Determining Organic Matter and Carbonates in Soil, by Lyle T. Alexander and Horace G. Byers. Department of Agriculture Technical Bulletin 317.

Effect of Solid and Gaseous Carbon Dioxide Upon Transit Diseases of Certain Fruits and Vegetables, by Charles Brooks and others. Department of Agriculture Technical Bulletin 318; 10 cents.

Effect of Inorganic Acids on the Physical Properties of Waterleaf Rag Bond Paper, by T. D. Jarrell and others. Department of Agriculture Technical Bulletin 334; 5 cents.

British Chemical Developments in 1931 and the Early Part of 1932, by Roger R. Townsend. Bureau of Foreign and Domestic Commerce, Trade Information Bulletin 809; 5 cents.

Heat Transfer from a Gas Stream to a Bed of Broken Solids, by C. C. Furnas. Bureau of Mines Bulletin 361; 10 cents.

Silver Consumption in the Arts and Industries of the United States in 1930 and 1931, by Charles White Merrill. Bureau of Mines Information Circular 6647; mimeographed.

Production of Explosives in the United States, 1931, by W. W. Adams and L. S. Gerry. Bureau of Mines Technical Paper 540; 5 cents.

Petroleum Refinery Statistics, 1930, by G. R. Hopkins. Bureau of Mines Bulletin 367; 15 cents.

Petroleum Refineries in the United States January 1, 1932, by G. R. Hopkins and E. W. Cochrane. Bureau of Mines Information Circular 6641; mimeographed.

Survey of Cracking Plants, January 1, 1932, by G. R. Hopkins. Bureau of Mines Information Circular 6648; mimeographed.

Smelting in the Lead Blast Furnace, Handling Rich Charges—X. Preparation of the Charge, by G. L. Oldright and Virgil Miller. Bureau of Mines Report of Investigations 3183; mimeographed.

Research Activities in the Mineral Industries of the United States, by A. C. Fieldner and Alden H. Emery. Bureau of Mines Information Circular 6637; mimeographed.

Pennsylvania Anthracite Coal Tables, 1931, by F. G. Tryon and H. L. Bennit. Bureau of Mines; mimeographed.

Mineral Production Statistics for 1931—preliminary mimeographed statements from Bureau of Mines on: natural gasoline; mineral production; Portland cement; barite and barium; road oil; masonry, natural, and puzzolan cement; by-product sulphuric acid at copper and zinc plants.

Mineral Production Statistics for 1931—Separate pamphlets from Bureau of Mines on: Salt, Bromine, and Calcium Chloride, by A. T. Coons, 5 cents; Carbon Black, by G. R. Hopkins and H. Backus, 5 cents.

Mineral Production Statistics for 1930—Separate pamphlets from Bureau of Mines on: Copper, by C. E. Julihn and H. M. Meyer, 5 cents; Ore-Concentration Statistics, by T. H. Miller and R. L. Kidd, 5 cents.

Production Statistics From 1931 Census of Manufactures in preliminary mimeographed form for: aluminum manufactures; batteries and battery parts; clay products (other than pottery) and nonclay refractories; druggists' preparations; glass and glassware; glue and gelatin; lime; mirrors and other glass products; paints and varnishes; patent or proprietary medicines and compounds; petroleum refining; pulp goods and molded composition products; roofing, asphalt shingles, roof coatings other than paint; tanning materials, natural dyestuffs, mordants and assistants, and sizes; tin and other foils, not including gold foil; wood preserving; abrasive wheels, stones, paper, and cloth, and related products; rayon and allied products; printing inks; wood distillation and charcoal manufacture; cleaning and polishing preparations; tin plate and terneplate; pottery; asbestos products, steam and other packing, pipe and boiler covering, and gaskets; beet sugar; cane sugar.

OTHERS' VIEWS

Jobs for Recent Graduates

To the Editor of Chem. & Met.:

Sir:—Your editorial on "Jobs for recent graduates" in your July issue leads me to quote part of the reply of a Western production manager to a questionnaire on which my committee is engaged.

"In general, the more college graduates we can get, the better we like it. Graduates in our employ are occupying jobs ranging from laborers all the way up to the president. . . . The labor gangs being used as feeders to the other organization parts are normally made up of about one third college graduates or undergraduates and the rest professional laborers. At present these are mostly professional laborers. We try to persuade undergraduates to "finish up" and return to us and are frequently successful in this. Such men are among our best. . . . We have not found that our turnover has been increased through employing a better educated class of men. On the contrary, in normal times our turnover was almost entirely among the uneducated or self-educated groups."

The young graduate might still find an opportunity to swing pick or pipe wrench and by personal contact learn something of the art of handling men, an art whose knowledge is still very rudimentary with many men who enter chemical work nearer the top.

R. E. Bowman,
Wilmington, Del.

Chairman, Committee on
Chemical Education of the
Non-Collegiate Type,
American Chemical Society.

Heat Transfer

To the Editor of *Chem. & Met.*

Sir—In the article, "Heat Transfer Through Industrial Glass Tubing," by the writers, in the June, 1932, number, the following errors appeared: In all places where r_1 appears, it should be changed to r_i! in equation (8) K^1 should read k'; and on page 317, column 2, top of column should read,

"Now plotting

$$\frac{\dfrac{1}{\log_e \dfrac{T_o - T_2}{T_o - T_2}}}{\dfrac{v}{\dfrac{cr_i^2}{2Lr_o}}} \text{ against } r_o \log_e \frac{r_o}{r_i}$$

J. T. Littleton, Jr.
H. C. Bates,
Corning, N. Y.

Corrosion, Heat and Abrasion Resistant Alloys

Errata—While Corrosiron and Pyrocast were listed in the *Chem. & Met.* data sheets for Modern Metals (See Items Nos. 120 and 205, pages, 507 and 510) published in the September, 1932, number, with manufacturer's name, physical and mechanical properties, the following data were omitted:

For Corrosiron the mean coefficient of thermal expansion, 600-1,250 deg. F. is 0.000014.

The manufacturer (Pacific Foundry Co., Ltd., San Francisco, Calif.) recommends Corrosiron for use in handling the following corrosives: acetic acid, all concentrations; aluminum chloride; aluminum sulphate; ammonia, anhydrous; ammonium chloride; ammonium hydroxide; ammonium nitrate; ammonium sulphate; butyl acetate; calcium chloride; carbon bisulphide; carbon tetrachloride; carbonic acid; chloracetic acid; chlorine water; chromic acid; citric acid; copper sulphate; ethyl acetate; fatty acids; ferric chloride; ferric sulphate; ferrous chloride; ferrous sulphate; formaldehyde; formic acid; hydrochloric acid, all concentrations; iodine; lactic acid; magnesium chloride; magnesium sulphate; mixed acid; nitric acid, all concentrations; nitrous acid; oxalic acid; phenol; phosphoric acid; sea water and brine; sodium bisulphate; sodium carbonate; sodium ferricyanide; sodium hydroxide, all concentrations; sodium hypochlorite; sodium nitrate; sodium phosphates; sodium sulphide; sodium sulphite; sulphuric acid, all concentrations; tannic acid; and oxidizing atmosphere, sulphur dioxide and trioxide gases at high temperatures.

Pyrocast was developed for a heat-resisting material, but it is also corrosion resistant to many of the common chemicals.

While Enduro AA, Enduro KA2, Enduro S-FC, and Toncan Iron were listed in the *Chem. & Met.* data sheets for Modern Metals (see items nos. 144, 147, 149, 247, pages 508 and 511) published in the September, 1932, number, with manufacturer's name, physical and mechanical properties, the following recommendations were omitted:

Enduro AA (144) is recommended by the manufacturer (Republic Steel Corp., Massillon, Ohio) for use in handling the following corrosives: acetic acid, all concentrations; acetone; ammonia, anhydrous; ammonium chloride; ammonium hydroxide; ammonium nitrate; ammonium sulphate; aniline; carbon bisulphide; carbon tetrachloride; carbonic acid; chromic acid; citric acid; copper sulphate; ethyl acetate; fatty acids; formaldehyde; formic acid; hydrogen peroxide, all concentrations; lactic acid; magnesium chloride; nitric acid, all concentrations; oxalic acid; phenol; phosphoric acid; sea water and brine; sodium carbonate; sodium ferricyanide; sodium hydroxide, very dilute and moderate dilution; sodium nitrate; sodium phosphates; sodium sulphide; sodium sulphite; sulphuric acid, concentrated; tannic acid.

Enduro KA2 (147) is recommended by the manufacturer (Republic Steel Corp., Massillon, Ohio) for use in handling the following corrosives: acetic acid, all concentrations; acetic anhydride; acetone; aluminum sulphate; ammonia, anhydrous; ammonium chloride; ammonium hydroxide; ammonium nitrate; ammonium sulphate; amyl acetate; amyl chloride; aniline; boric acid; butyl acetate; calcium hypochlorite; carbon bisulphide; carbon tetrachloride; carbonic acid; citric acid; copper sulphate; ethyl acetate; fatty acids; ferric sulphate; ferrous sulphate; formaldehyde; iodine; lactic acid; magnesium sulphate; nitric acid, all concentrations; nitrous acid; oxalic acid; phenol; phosphoric acid; sea water and brine; sodium carbonate; sodium ferricyanide; sodium hydroxide, all concentrations; sodium hydrosulphite; sodium hypochlorite; sodium nitrate; sodium phosphates; sodium sulphate; sodium sulphide; sodium sulphite; sulphuric acid, moderate dilution and concentrated; sulphurous acid; and tannic acid.

Enduro S-FC (149) is recommended by the manufacturer (Republic Steel Corp., Massillon, Ohio) for use in handling the following corrosives: acetic acid, very dilute; ammonium chloride; ammonium nitrate; ammonium sulphate, carbon tetrachloride; citric acid; copper sulphate; ferric sulphate; formic acid; lactic acid; nitric acid, very dilute and moderate dilution; oxalic acid; phenol; phosphoric acid; sea water and brine; and tannic acid.

Toncan Iron (247) is recommended by the manufacturer (Republic Steel Corp., Massillon, Ohio) for use in handling the following corrosives: acetic acid, very dilute and concentrated; ammonia, anhydrous; ammonium chloride; ammonium hydroxide; ammonium nitrate; ammonium sulphate; benzaldehyde; boric acid; carbon tetrachloride; carbonic acid; chlorine water; chromic acid; citric acid; ethyl acetate; fatty acids; formaldehyde; formic acid; hydrochloric acid, very dilute and moderate dilution; hydrogen peroxide, 3 per cent; lactic acid; oxalic acid; phenol; sea water and brine; sodium bisulphate; sodium bisulphite; sodium carbonate; sodium ferricyanide; sodium hydroxide, very dilute and moderate dilution; sodium hydrosulphite; sodium hypochlorite; sodium nitrate; sodium phosphates; sodium sulphate; sulphuric acid, all concentrations; sulphurous acid; tannic acid; and reducing atmosphere at high temperature.

Armco Ingot Iron (2): thermal conductivity, at room temperature is .16 cal. per sec, per sq.cm. per deg. C.

Dowmetal (25) is available in castings as well as bar, hot rolled, plate, sheet and tube.

PLANT NOTEBOOK

Protective Compounds for Idle Equipment

By E. R. WOODWARD
Firestone Tire & Rubber Co.
Akron, Ohio

WHILE executives concentrate on economic problems and endeavor to reduce controllable costs, a timely, though easily overlooked, source of saving is to be found in the application of the rust inhibitors popularly known as slushing compounds.

During these days of curtailed production in industry millions of dollars' worth of equipment—to say nothing of enormous stocks of iron and steel shapes and sections—is lying idle and the ravages of rust are taking their toll.

The best rust inhibitors have a petroleum base, the chemical stability of which offers maximum resistance to oxidation, thus giving to the product non-drying qualities. Obviously the first requirement of a rust inhibitor is that it shall be acid-free, and for this reason it is important to realize that not every petroleum residue is suitable. In addition to an acid-free petroleum base some products contain an active rust inhibitor employing a chemical principle not unlike to that used in the making of stainless alloys: the petroleum base is emulsified with a chromate solution.

One leading manufacturer makes a product of this kind in three consistencies—one hard, another soft, and a third in liquid form. The hard variety is most easily applied when hot. It should be melted in a steam-jacketed or a water-jacketed kettle at a temperature not over 150 deg. F. Overheating may precipitate the chromate salt. Applied with a paint brush this grade has a covering capacity of 140 sq.ft. per pound at 130 deg. F. In case it is desired to dip articles, this rust inhibitor should be heated to about 150 deg. F. The covering capacity under these conditions, however, will be considerably reduced.

The soft variety of rust inhibitor has a covering capacity of 310 sq.ft. at 120 deg. F. when applied with a brush.

Since it is a liquid, the third type may readily be applied hot or cold as circumstances require. Maximum heating temperature for this product, however, should not exceed 110 deg. F. It has a covering capacity of 350 sq.ft. at 90 deg. F. when brushed on.

In addition to their protective value for use on idle machinery and stocks of metallic material during a depression period, these rust inhibitors or slushing compounds are indispensable in times of normal business activity for such purposes as: coating bright parts of automobiles and machinery for export; coating angle bars, fish-plates, joint bolts and switch bearings on railroad tracks; protecting contracting and other machinery doing outdoor work; and avoiding deterioration of standby equipment or apparatus being held for reclamation or future use. They act not only as rust preventives but also as lubricants in cases where the treated parts may soon be put into service.

The U. S. Bureau of Standards has published some valuable information on rust preventives in Technical Paper 176 and Circulars 200 and 214. A suggested specification for a rust inhibitor might contain the following provisions: The coating shall adhere firmly at all temperatures to which it will be exposed, but shall be readily removable with cotton waste soaked in kerosene. Polished iron, steel, copper or brass after treatment shall not stain when exposed to weather at temperatures below 212 deg. F. for five days.

Typical formulas are given as follows:

1. 20 parts rosin (H grade), 100 parts petrolatum, 10 parts kerosene. The rosin is to be melted and mixed with the hot petrolatum, after which the kerosene is stirred in. The rosin greatly increases the adhesiveness of the petrolatum. Wax may be added to raise the melting point.
2. 3 parts candelilla wax, 6 parts H rosin, 50 parts petrolatum.
3. 2 parts carnauba wax, 5 parts H rosin, 50 parts petrolatum. Melt the ingredients together at 225 deg. F., stir and cool.

Comparison of A.S.M.E. Fusion-Welding Requirements For Unfired Pressure Vessels*

To assist engineers in understanding the differences between Class 1 and Class 2 fusion welding, as defined by the new A.S.M.E. Code, L. G. Haller of the Hedges-Walsh-Weidner Co., Chattanooga, Tenn., prepared a chart which he brought to our attention and which has been used in the preparation of the slightly modified chart appearing below.

	CLASS 1	CLASS 2
X-ray test	All longitudinal seams and one circular seam	None required
Stress relief	Yes	Only in rare instances
Plate thickness	Unlimited	1¼ in. maximum
Allowed efficiency of weld	90 per cent of solid plate	80 per cent of solid plate
Qualifications of welders	Class 1 welders required; two coupons attached to shell plate being welded, one on each end of one longitudinal joint of each vessel	Class 2 welders required; welder qualified by making only one coupon every six months
Bend test	30 per cent elongation of outside fibers	20 per cent elongation of outside fibers for electric welding; 15 per cent for oxyacetylene
Tensile test of joint	At least equal to the minimum of the range of plate on one coupon taken from every vessel	Equal to 95 per cent of minimum range of plate on one test coupon only, made once every six months
All-weld-metal test	20 per cent elongation in 2 in.	None required
Weld metal specific gravity test	7.80 minimum	None required
All-weld-metal tensile test for plates ½ in. and heavier	Equal to plate	None required
Purposes for which classes of welding may be used	All classes of pressure vessels	All vessels excepting those containing lethal gases or lethal liquids and/or those containing liquids operating at a temperature of 300 deg.F. or above. The maximum pressure at which any vessel in this class may be operated is 400 lb. per square inch, and/or the maximum temperature is 700 deg. F. and the plate thickness as required by the permissible stress allowance shall not exceed 1¼ in. This pressure limitation does not apply to vessels operated under hydraulic pressure at atmospheric temperature.

NOTE: A.S.M.E. Boiler Code for fusion welding is same as Class 1 for unfired pressure vessels, except all seams are required to be X-rayed.

The main difference between Class 1 and Class 2 welding aside from the annealing and X-raying is that Class 1 work is **continuously checked** on every job by physical tests made of coupons attached to each vessel, while Class 2 work is checked only once every six months.

*For full details see the 1931 issue of A.S.M.E. Code for Unfired Pressure Vessels, which can be secured from the American Society of Mechanical Engineers, 29 West 39th St., New York City.

NEW EQUIPMENT

Dorr Sells Turbo-Mixer • Proportioning Equipment • Improved Hytor • Mullite Brick • Mill for Fibrous Materials • Dust Precipitator • Unique Flow Meter • Double-Arm Mixer • Sieve Shaker • Automatic Level Control • Self-Operated Regulator • Automatic Batching Scale • Propeller Pump • Anti-Balancing Steam Trap • Priming Unit • Cooling and Condensing Units • Electric Steam Generator • Weld Fittings • Forced-Feed Faucet • Photo-electric Relay • Aerating Filter • "En Masse" Conveyor • Motorized Speed Reducers • Automatic Batch Weigher • Manufacturers' Latest Publications

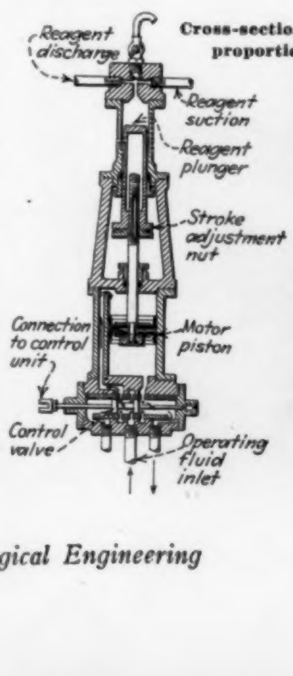
Dorr Sells Turbo-Mixer

Through recent arrangements made with the Turbo-Mixer Corp., The Dorr Co., 247 Park Ave., New York City, has acquired exclusive sales rights for the Turbo-Mixer and other Turbo equipment in certain of its principal fields. Henceforth The Dorr Co. will offer agitators and mixers of both its own and Turbo-Mixer design.

Proportioning Equipment

For the accurate feeding of small quantities of reagents in proportion to the flow of process fluids, a number of new pieces of equipment have recently been designed and offered by "Proportioneers," 7701 Avalon Ave., Chicago, Ill. The heart of this line is a device known as the "Tret-O-Unit" which consists of a hydraulically balanced control valve that is shuttled back and forth so as to control the number of strokes per minute taken by a small fluid motor which is shown in the accompanying drawing directly above the control valve. The motor drives a plunger pump which picks up reagent from any receptacle and discharges it into the untreated fluid line.

Shuttling of the control valve may be accomplished by any suitable device used to measure the rate of flow of the untreated fluid, such as a mechanical meter, reciprocating pump or liquid rotor. The company is prepared to supply a number of types of special metering equipment. The "Tret-O-Unit" itself is available with the reagent end constructed of a wide variety of corrosion-resistant materials, both metallic and non-metallic. When desired, a diaphragm may be substituted for the plunger. The device is also adaptable to automatic fluid sampling and to the driving of dry-chemical feeders at a rate proportional to the flow of the fluid being treated.



Cross-section of automatic proportioning pump

Improved Hytor

Nash Engineering Co., South Norwalk, Conn., has announced the development of the new "Cone-Type" Hytor vacuum pump and compressor, which is said greatly to increase the efficiency and pressure in the vacuum range of the Hytor. The principle of operation is similar to that of the standard Hytor but the suction and discharge ports are now placed on conical surfaces which extend into the rotor from either side of the pump. The new pumps are said to maintain vacuum up to 28 in. of mercury and pressures up to 35 lb. per square inch. They are available in ratings of conventional displacement ranging from 72 to 5,750 c.f.m.

Mullite Brick

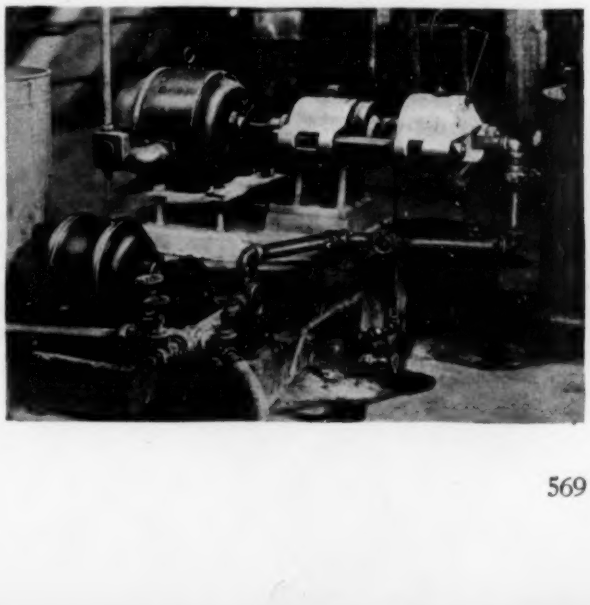
Resistance to slag action and spalling, combined with high refractory qualities, are said to be outstanding characteristics of a mullite firebrick recently developed by the Laclede-Christy Clay Products Co., St. Louis, Mo. This brick is said to have all the desirable features of the so-called super-refractories at a price only slightly higher than first-quality firebrick.

Mill for Fibrous Materials

According to the U. S. Colloid Mill Corp., Long Island City, N. Y., it has heretofore been impossible to use colloid mills successfully with materials of fibrous texture. This company has just developed a new rotor for its Type S-R mill which is said to permit the mill to be used for the grinding and dispersion of fibrous and flake materials and to reduce them to such a degree of fineness that they appear almost to go into solution in water.

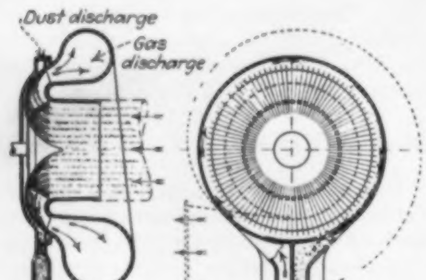
Mills equipped with the new rotor are available in capacities from 5 to 1,000 gal. per hour. They are intended for the treatment of such materials as sawdust, vegetable fibers, cellulose acetate, cotton, seeds, and similar products.

Type S-R mill for fibrous materials



Dust Precipitator

Conveying and collecting dust are combined in a single machine, known as the "Turbo-Clone" dynamical precipitator, which has recently been developed by the American Air Filter Co., Louisville, Ky. In appearance, the new machine looks very much like a conventional heavy-duty blower fan, but an examination of its structural details, particularly the impeller, reveals its differences. Reference to the accompanying drawing shows how the dust is



Schematic diagram of Turbo-Clone

sucked into the center of the impeller where it is deflected by the cone, passing outward through a multiplicity of hyperboloid blades. The dust tends to follow the curved impeller disk, from which it passes to the annular discharge. Extensions on the tips of the blades carry the dust around the discharge to the bottom, where the particles are removed by a skimmer and fall into an airtight dust hopper. The air or other gas continues into the scroll-shaped discharge, leaving the precipitator as it would an ordinary fan.

The Turbo-Clone's precipitating efficiency is said to range up to 99.5 per cent, depending on the nature and concentration of the dust. For higher pressures or efficiencies two or more Turbo-Clones may be operated in series.

Unique Flow Meter

Wide measuring range, accuracy and an abundance of power are said to be features of the new "Chronoflo" meter developed by Builders Iron Foundry, Providence, R. I. The instrument uses either a Venturi tube or an orifice plate to produce a differential pressure dependent upon the flow and employs electrical indication and recording at a distance. Essentially, it consists of a Telechron-driven contact device the duration of contact of which is controlled by the height of the mercury column in the mercury unit. A Telechron-driven register-recorder operates during the exact time that the contact is completed. The recorder employs an evenly divided chart and includes an integrator for totalizing the flow. The connection between the recorder and the pipe line may be of any length and may even employ the public telephone system where distances are exceptionally long.

Double-Arm Mixer

Working capacity of from 2 to 4 gal. is provided in a new laboratory and small-production-size double-arm mixer announced by the Wolf Co., Chambersburg, Pa. This is one of a line of mixers ranging in capacity to 1,000 gal. This model, No. 5, permits accurate small-scale production with expenditure of little power. When desired, it can be equipped for use under pressure or vacuum, with or without jackets for the circulation of fluids to heat or cool the mixer contents.

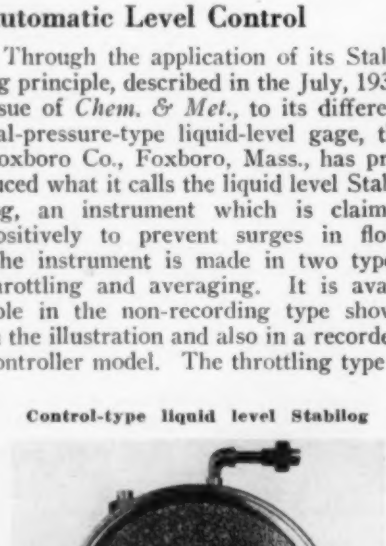
Sieve Shaker

For plant control of particle sizing, the Newark Wire Cloth Co., Newark, N. J., has developed what it calls the "End-Shak" testing sieve shaker. This machine is said to eliminate variable factors and to bring the results of laboratory and plant into closer relationship by applying fundamentally sound principles of screening. It weighs 275 lb. including its motor and automatic timing switch. It will handle up to 13 sieves.

Automatic Level Control

Through the application of its Stabilog principle, described in the July, 1931, issue of *Chem. & Met.*, to its differential-pressure-type liquid-level gage, the Foxboro Co., Foxboro, Mass., has produced what it calls the liquid level Stabilog, an instrument which is claimed positively to prevent surges in flow. The instrument is made in two types, throttling and averaging. It is available in the non-recording type shown in the illustration and also in a recorder-controller model. The throttling type is

Control-type liquid level Stabilog



used where it is desired to hold a close level and yet avoid surges in the controlled flow. In this way, any sudden change in the inflow will be partly absorbed in the vessel. The averaging type allows the level to vary within safe limits, but holds the outflow as nearly uniform as possible, consistent with these limits. Cooperating with the surge tank, this type tends to average out variations in the inflow.

This company has also announced the development of a new type of recording, contact-making controller to which has been given the name, "Rotax." It employs rotating or commutator-type contacts which are said to permit uninterrupted pen travel, at the same time giving more accurate control than previous contact controllers. The Rotax method is applicable to instruments for controlling temperature, pressure, humidity, flow and liquid level.

Self-Operated Regulator

Control of the temperature and simultaneous protection of the heating element against excessive pressure are provided by the new Type ETD regulator recently introduced by the Spence Engineering Co., 110 East 42d St., New York City. The pressure control feature is said to eliminate the need for a separate reducing valve. The regulator consists of a single-seated control valve operated by a diaphragm which in turn is controlled by a temperature-operated pilot valve and a pressure-control pilot. Pressure of the fluid being controlled is used to move the diaphragm and regulate the valve which is said to give tight shut-off on dead-end service.

Automatic Batching Scale

Using a novel lever system and set of beams, Toledo Precision Devices, Inc., Toledo, Ohio, has developed an automatic weighing device which reduces the batching of materials to a simple cycle of lever and button operations. One beam is provided for each ingredient that enters the mix, and these beams are connected in turn to a Toledo scale equipped with a photoelectric tube. Through button control, flow of one material is started and when the predetermined weight is reached, the flow is shut off by the photoelectric device. Then the cycle is repeated with the next beam weighing the next material.

Propeller Pump

Pumping against heads up to about 40 ft. is said to be economically handled with the propeller type of pump recently developed by the De Laval Steam Turbine Co., Trenton, N. J. In pumps of this sort, operation is at high rotative

speeds and the liquid flows through the pump in smooth lines without abrupt turns or changes of direction. The pump is adapted to the handling of large quantities of water, as for condenser cooling water. It is built for both horizontal and vertical installation and is available for all capacities. It may be direct connected to a standard-speed electric motor or steam turbine.

Anti-Balancing Steam Trap

Special design of the air vent is said to be an outstanding feature of a new series of inverted bucket steam traps recently introduced by The Strong, Carlisle & Hammond Co., 1392 West 3d St., Cleveland, Ohio. The traps, known as Nos. 70 and 71, use a quick-opening air valve in the top of the bucket which is designed to open wide as the bucket begins to lose weight, thus preventing balancing and causing the bucket to sink suddenly so as to open the trap discharge valve. It is claimed that these traps will handle more air than older types.

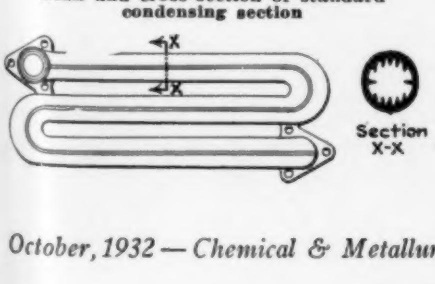
Priming Unit

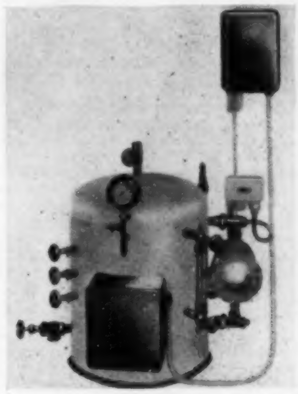
Automatic priming of practically any centrifugal pump of its manufacture has recently been announced by the Worthington Pump & Machinery Corp., Harrison, N. J. Priming is accomplished by the addition to the pump of an electrically driven evacuator of the Nash Hytor type which automatically operates to remove air whenever the discharge pressure of the centrifugal pump is below a predetermined point.

Cooling and Condensing Units

Four types of cast-metal cooling and condensing units of novel design have recently been put on the market by the National Radiator Corp., Johnstown, Pa. The units are intended for use in petroleum refineries, coke plants and other process industries and are characterized by ribbed interiors and smooth exteriors. The purpose of the ribs is to make the heat absorbing power of the interior surface equal to the heat dissipating power of the smooth exterior surface. Swirler fins placed at 15 deg. to the angle of flow create turbulence and, according to the manufacturers, further increase the rate of heat transfer. Among the advantages claimed for the units may be enumerated ease in removing scale and dirt from the exterior surface; ready connection of units in series, with attendant economy in space, material and labor; high heat transfer; and the availability of corrosion-resisting materials, including gray cast iron, Ni-Resist, other alloy cast irons and non-ferrous metals.

Plan and cross-section of standard condensing section





30 kw. generator

Electric Steam Generator

Requirements for small or moderate volumes of process steam at pressures up to 200 lb. may be met economically, according to the Commonwealth Electric & Manufacturing Co., 93 Boston St., Boston, Mass., through the use of a new line of fully automatic, electric steam generators which it has recently developed. Six standard models range in capacity from 7.5 to 90 kw. for voltages of 110 or 220. Among the advantages claimed are: no hazard, no attendance, automatic operation, quick steaming with steam generated only as needed, and low maintenance. The units are said to be competitive with fuels where the energy rate is 3 cents per kilowatt-hour or less.

Weld Fittings

Midwest Piping & Supply Co., St. Louis, Mo., has recently placed on the market a line of shaped welding nipples which eliminate all templates when saddling one pipe upon another. The nipples are available in both 90-deg. and 45-deg. types, and are made in sizes from 1¼ to 12 in. in wrought steel and wrought iron pipe.

Forced-Feed Faucet

For the removal of plastic compounds and other slow-flowing mixtures from bulk containers, the Key Boiler Equipment Co., East St. Louis, Ill., has developed the LeMay forced-feed faucet to be used on drums equipped with standard 1½-in. pipe openings. A worm extending into the drum is rotated by a crank attached to the faucet, resulting in positive withdrawal of material.

Photoelectric Relay

Combining a photoelectric cell, amplifier and light source in a single case is said greatly to simplify the work of installation of a new model of photoelectric relay recently brought out by the G-M Laboratories, 1735 Belmont Ave., Chicago, Ill. The light beam which is to be interrupted is reflected back to the photoelectric cell from a mirror placed at any convenient point. The unit is said to be capable of operating at speeds as high as 600 light interruptions per minute.

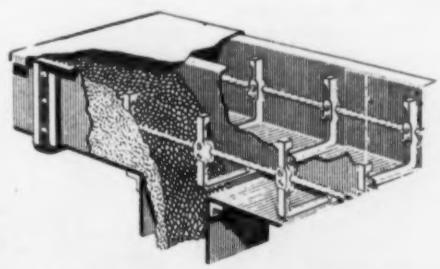
Aerating Filter

Removal of iron from water is accomplished by a new aerating filter that has been put on the market by the Elgin Softener Corp., Elgin, Ill. Water is pumped directly into a pressure filter tank, the top portion of which is filled with compressed air. As water sprays through the compressed air it absorbs oxygen to oxidize the ferrous iron to the ferric state. The water then falls into the central section of the tank which acts as a retention chamber. During the passage of the water through this chamber, coagulation takes place, so that when the water reaches the sand filter in the lower part of the tank, the iron is effectively removed. Filters of this type may be used in advance of a zeolite type of water softener.

"En Masse" Conveyor

What is called "en masse" conveying is the new principle employed in the Redler conveyor, recently introduced into the United States by the Redler Conveyor Co., 117 Liberty St., New York City. The new conveyor induces a continuous, quiescent, compact flow of solids much like the flow of water through a pipe. It is said to be capable of operating vertically, horizontally or at any angle.

The accompanying drawing illustrates



Section of horizontal Redler conveyor

the construction of one form of Redler conveyor. Fingers attached to a cable move the material through an inclosed trough. It is claimed that the power consumption is low as it is only necessary to overcome the frictional resist-

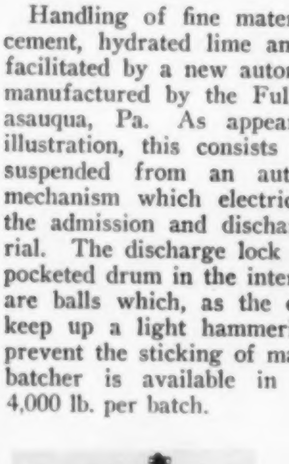
ance of the material flowing through the trough, plus any useful work done in elevating, with an additional small item for the slack side return run and mechanical losses in the drive system. Material is always set in motion on a horizontal run, after which it may be taken vertically or up an incline. The system is said to be extremely flexible and to be suitable with a variety of materials including chemicals, clays, food products, coal, coke, bauxite, etc. Several designs of conveying element have been developed to meet various conditions.

Motorized Speed Reducers

Philadelphia Gear Works, Philadelphia, Pa., has announced two new motorized speed reducers, a vertical reducer for agitating and mixing equipment, and a general-purpose, horizontal, motorized reducer. The new equipment has been given the name of "Moto-Reducer" and is being built in single, double and triple types, with ratios up to 450 to 1, furnished with standard, open type or totally inclosed, fan-cooled motors, polyphase or single phase. Both types are built to occupy a minimum of space and are equipped with hardened nickel steel, helical-cut gears operating in oil baths, with the bearings of the anti-friction type.

Automatic Batch Weigher

Handling of fine materials such as cement, hydrated lime and gypsum is facilitated by a new automatic batcher manufactured by the Fuller Co., Catasauqua, Pa. As appears from the illustration, this consists of a hopper suspended from an automatic scale mechanism which electrically controls the admission and discharge of material. The discharge lock consists of a pocketed drum in the interior of which are balls which, as the drum rotates, keep up a light hammering and thus prevent the sticking of materials. The batcher is available in sizes up to 4,000 lb. per batch.



Automatic batcher for pulverized materials

MANUFACTURERS' LATEST PUBLICATIONS

Apparatus. American Instrument Co., 774 Girard St., N.W., Washington, D. C.—Bulletin 151—4 pages on the Vogel-Ossag viscometer; Bulletin 1001, 4 pages on relays for laboratory and industrial use; Bulletin 1700, leaflet describing hydrogenation apparatus for laboratory use.

Apparatus. American Platinum Works, N.J.R.R. Ave. at Oliver St., Newark, N. J.—Folder describing a new light-weight platinum crucible for student use.

Apparatus. Podbielniak Analytical & Research Laboratories, 112 N. Lansing St., P.O. Box 567, Tulsa, Okla.—Circular 7 and Price List 70—respectively 12 and 16 pages on the new high-temperature fractional distillation analysis apparatus, Models B and C, made by this company.

Apparatus. Yonkers Laboratory Supply Co., 515 West 132d St., New York City—Bulletin 45—4 pages on laboratory apparatus including a portable burette for use in knock-testing.

Blowers. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin 1908—4 pages on this company's single-stage turbo-blowers.

Blowers. The Elliott Co., Pittsburgh, Pa.—Bulletins P-4 and 5—Respectively 32 and 20 pages on centrifugal blowers and compressors, multi-stage and single-stage types.

Cleaning. International Distributors, Inc., 333 N. Michigan Ave., Chicago, Ill.—32 pages on the "Kerrick Kleaner" manufactured by the Chemical Processes Co., Los Angeles, Calif. This is a moderate-pressure process, capable of employing a variety of detergents.

Control. The Foxboro Co., Foxboro, Mass.—Bulletin 177—48 pages on temperature controllers, charts and accessories. Catalog introduces a novel self-indexing system.

Crushers. Traylor Engineering & Mfg. Co., Allentown, Pa.—Bulletin 111—10 pages on gyratory crushers made by this company.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Bulletin GEA-1366, totally inclosed hoist motors; GEA-1628, general-purpose, squirrel-cage induction motors.

Electrical Equipment. Wagner Electric Corp., 6400 Plymouth Ave., St. Louis, Mo.—Bulletin 172, Part 4B—Leaflet on air-cooled transformers; Bulletin 174, Part 5, 6 pages on multi-speed motors, describing types and applications.

Electrical Equipment. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.—Circular 1958, 12 pages on "De-Ion Grid" indoor oil circuit breakers; Circular 1771-B, 8 pages on oil circuit breakers.

Equipment. Jeffrey Mfg. Co., Columbus, Ohio—Leaflet describing special alloy parts for grinding mills and bucket elevators.

Fluid Handling. Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: W-850-B8, 4 pages on portable compressors; D-445-S2, Hydraulic bypass and check valves; D-111-S4, 8 pages on steam pumps for highly volatile liquids.

Furnaces. W. S. Rockwell Co., 50 Church St., New York City—Publications as follows: Bulletin 332, Electric convector furnaces; 333, Belt-conveyor electric and fuel continuous furnaces; 339, 8 pages on heating and cooling wire, the principles of which are applicable to most heating problems.

Hard Rubber. B. F. Goodrich Rubber Co., Akron, Ohio—Information on hard rubber in sheet, rod and tubing form.

Heaters. Griscom-Russell Co., 285 Madison Ave., New York City—Form 484—2 pages on this company's storage tank oil heaters.

Heaters. Harold E. Trent Co., 618 N. 54th St., Philadelphia, Pa.—Leaflet describing electric immersion heaters.

Materials Handling. Clark Tructractor Co., Battle Creek, Mich.—Booklet briefly describing this company's line of gas-powered lift trucks and other materials handling equipment.

Materials Handling. Gifford-Wood Co., Hudson, N. Y.—Bulletin 122—20 pages on storage and handling of coal.

Materials Handling. Philadelphia Gear Works, Erie Ave. & G St., Philadelphia, Pa.—Folder describing a new trolley-type electric hoist made by this company in six sizes ranging from ¼ to 3 tons capacity.

Metals. American Sheet & Tin Plate Co., Pittsburgh, Pa.—25 pages on physical properties and chemical data relating to this company's stainless steel sheets and light plates.

Mixers. Robinson Mfg. Co., Muncy, Pa.—Bulletin 32-C—47-page catalog describing Gardner and Unique mixers, in all sizes and for all purposes.

Ovens. Freas Thermo-Electric Co., Irvington, N. J.—Bulletin 101—7 pages on this company's low-range, pressure-temperature control cabinets for laboratory and industrial use.

Packages. National Metal Edge Box Co., Callowhill at 12th St., Philadelphia, Pa.—24 pages on fiber boxes, fabricated with metal edges.

Plastics. Continental-Diamond Fibre Co., Newark, Del.—Leaflet briefly describing "Vulcoid," a laminated fibrous base insulating material which is thermoplastic and capable of easy machining.

Power Transmission. Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.—Catalog 302 Revised—Complete information on this company's line of speed-reducing equipment.

Power Transmission. D. O. James Mfg. Co., 1114 W. Monroe St., Chicago, Ill.—Folder describing a flexible coupling made by this company.

Protective Helmet. The W. W. Sly Mfg. Co., Train Ave., Cleveland, Ohio—Bulletin S-65—Folder describing this company's new "Purair" helmet and auxiliary equipment for protection against dust and fumes.

Pumps. Baldwin-Southwark Corp., Philadelphia, Pa.—Bulletin 36—12 pages on high-pressure hydraulic pumps in all capacities; also includes description of this company's new "Hydro-Gas" accumulator system.

Pumps. DeLaval Steam Turbine Co., Trenton, N. J.—Catalogs B-4 and B-5—Respectively 16 and 24 pages on single-stage, double-suction centrifugal pumps and single-suction, multistage centrifugal pumps.

Pumps. Warren Steam Pump Co., Warren, Mass.—Bulletin 202-2—8 pages on centrifugal stock pumps for handling liquids with solids in suspension.

Pyrometers. Industrial Pyrometer Co., 343 Mintor Ave., Painesville, Ohio—Leaflet describing the K & S pocket radiation pyrometer.

Refractories. Quigley Co., 56 W. 45th St., New York City—Leaflet describing a new castable refractory for forming special shapes; gives instructions for use.

Refractory Cement. Chas. Taylor Sons Co., Cincinnati, Ohio—Booklet describing this company's new "Tayco" refractory cement for high temperatures.

Refrigerants. Roessler & Hasslacher Chemical Co., 350 Fifth Ave., New York City—55 pages on the properties and use of "Artic," this company's methyl chloride refrigerant.

Refrigeration. Foster Wheeler Corp., 165 Broadway, New York City—Bulletin WJ-32-6—12 pages describing new developments in the design and application of vacuum refrigerating systems.

Return Bends. Stockham Pipe & Fittings Co., Birmingham, Ala.—12-page folder describing a complete line of return bend fittings for oil refining.

Safety Equipment. Mine Safety Appliances Co., Pittsburgh, Pa.—Folder describing leather and rubber protective footwear.

Stainless Tubes. Carpenter Steel Co., 100 Broadway, New York City—Folder describing properties of, and giving working instructions for, this company's welded stainless steel tubes.

Steam Generation. Babcock & Wilcox Mfg. Co., 85 Liberty St., New York City—Bulletin G-2—39-page condensed catalog completely covering products of this company including steam generating, grinding and waste-heat-recovery, equipment, refractories, special process equipment and special-vapor heat-transfer systems.

Steam Generation. Combustion Engineering Corp., 200 Madison Ave., New York City—4 pages on a new small stoker, Type E, developed for boilers of 40 to 150 boiler horsepower.

Water Treatment The Permutit Co., 440 Fourth Ave., New York City—36-page book entitled "No Scale, No Sludge, No Mud," describing the application of zeolite water softeners in the treatment of boiler feed water.

Welding. Lincoln Electric Co., Cleveland, Ohio—8 pages on the new "Shield-arc" welder made by this company.

NEWS OF THE INDUSTRY

Decided by poll of exhibitors the Chemical Exposition has been postponed until December, 1933. Technical association of the paper industry draws up specifications for chromium-nickel-iron castings for sulphite pulping. Chemical section of National Safety Council witnesses large scale demonstrations of releasing dust explosion pressures

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Chemical Show Postponed Until December, 1933

Following protracted negotiations between the management of the Chemical Exposition and a group of New York exhibitors, it has been decided to postpone the fourteenth National Exposition of Chemical Industries until the week of December 4, 1933. An informal poll of the exhibitors showed that an overwhelming majority was in favor of the later date. The change was made in order to give the exhibitors more time to prepare their exhibits and at the same time to build up the interest of the industries in order to assure a larger attendance of engineers and technical men.

The fact that the new dates coincide with those for the annual meetings in New York of the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers has been cited as an added incentive for it should help to attract engineers from these closely allied fields. The American Institute of Chemical Engineers normally meets during this same week but as yet there has been no final decision as to its meeting place.

Following the conferences between the International Exposition Company and the New York group, which resulted in the postponement, the latter suggested that a temporary committee be appointed to represent the exhibitors and to cooperate with the exposition management until such time as a more permanent committee could be elected. Accordingly, another poll was taken and more than a hundred exhibitors authorized the following committee to act in their behalf in matters pertaining to the general arrangements for the exposition: A. E. Marshall, of the Corning Glass Works; Howard Farkas, of The U. S. Stoneware Co.; Guy N. Harcourt, of the Buffalo Foundry & Machine Co.; K. E. Moore, of the Johns-Manville Corp.; H. C. Russ, of the Abbe Engineering Co. and F. H. Jones, of the Dorr Co., Inc.

Chemical Safety Men Witness Dust Explosions

Large scale demonstrations designed to show the possibility of releasing dust explosion pressures through properly proportioned vents without structural damage to buildings, were staged at Arlington, Va., on Oct. 4 as a part of the program of the chemical and food sections of the National Safety Council. Dr. David J. Price, principal engineer in charge of the chemical engineering division, Bureau of Chemistry and Soils, explained the work of his department to more than a hundred interested spectators. H. R. Brown and Richard L. Hanson, conducted the demonstrations which were made in an experimental room, gallery and tower, especially constructed for this purpose. Explosions were made with grain dust, soap powders, starch dust, milk powder, sugar dust, wood charcoal dust and cork dust. In all cases it was conclusively demonstrated that adequate safety provisions are now available which will prevent structural damage when proper precautions are taken.

Officers elected by the chemical section of the National Safety Council include the following: John Roach, deputy commissioner of labor for the State of New Jersey was elected chairman to succeed John S. Shaw of the Hercules Powder Co. A. L. Armstrong of Eastman Kodak Co. was elected vice-chairman in charge of the program, and George H. Miller, vice-president in charge of engineering. Ralph O. Keefer of Aluminum Company of America was re-elected secretary. The new editor of the News Letter is F. W. Dennis, personnel director of the Hooker Electrochemical Co., Niagara Falls.

Student Chapter Awards Made by A.I.Ch.E.

Checks in the amounts of $100.00, $50.00, and $25.00, respectively have been mailed by the American Institute of Chemical Engineers to G. H. Hickin of the University of Michigan, Edmund Field of Armour Institute of Technology and Melvin J. Sterba of the University of Wisconsin. These awards are the first to be made in a national competition which will be conducted annually among the 1,400 members of the student chapters of the Institute. Its purpose is to stimulate professional interest in chemical engineering among students and thus supplement the work of the Committee on Chemical Engineering Education.

The competition this year consisted of a contest problem in the calculation of the design of a heat exchanger system for an oil refinery. More than thirty solutions were submitted and studied by a sub-committee, appointed by Prof. E. M. Baker, chairman of the Institute's Advisory Committee on Student Chapters. The sub-committee consisted of Walter G. Whitman, Earl P. Stevenson, H. O. Forrest and Francis J. Curtis.

George Hickin, winner of the first prize, received a bachelor's degree in chemical engineering at the University of Michigan at the conclusion of summer school in August, 1932. During his school course he worked in the engineering research department on vapor phase cracking of petroleum and on an investigation of portland cement. Edmund Field, winner of the second prize graduated in June from Armour Institute with a 95 average in his studies. He has received an assistantship in chemistry at Northwestern where he plans to specialize in physical chemistry and mathematics.

Specifications Form Keynote Of T.A.P.P.I. Meeting

With a large attendance of members and guests the fall meeting of the Technical Association of the Pulp and Paper Industry was held at Holyoke, Mass., on Sept. 14-16. As in previous years the symposium plan was followed with the program including discussions on the problems of paper manufacture and on pulp classification and specifications.

The meeting was noteworthy because it emphasized the consideration which the technical branch of the industry has been given toward drawing up its own standards and specifications for materials and equipment used in paper production.

Classification of chemical wood pulps and the possibility of establishing purchase specifications for them were widely discussed.

The report of the Materials of Construction Committee was presented before a number of metallurgists as well as the attending paper men. The proposal of the association to draw up its own specifications for chromium-nickel-iron castings for sulphite pulping equipment had extended interest in this question beyond the paper industry itself. The report included proposed specifications for such castings.

Limitations of time prevented a detailed discussion of the specifications in the open meeting. However, an informal meeting was held later where the discussion was continued with the result that it was decided to arrange for a future meeting of producers for the express purpose of considering the proposed specifications, and the suggested modifications, with the hope of arriving at a satisfactory form of specification that could be submitted to the Materials of Construction Committee for their approval, and that of the technical association.

The specifications were again discussed and further modified at a meeting held in Buffalo on Oct. 4 in conjunction with National Metal Congress and Exposition. Final disposition of the specifications is expected to be made at the annual meeting of T.A.P.P.I. which will be held next February.

New Designs Will Feature Power Show Exhibits

Results of research and progress in engineering will feature the exhibits which will be on view at the Tenth National Exposition of Power and Mechanical Engineering at Grand Central Palace, New York, Dec. 5-10.

Several firms will illustrate the research that has been going on to develop the best materials and alloys to meet the service demands of high pressure and high temperature in the modern power plant. Another will show by microscopic slides and micro-photographs, cultures, etc., how slime is formed on condenser tubes and how to effectively combat it.

Automatic control will occupy an important place among the exhibits. It has made marked progress during the past two years and numerous devices of this character will be shown in actual operation. One firm will show several new electrical devices for temperature control. Another will exhibit new optical pyrometers and a super-sensitive radiation tube that permits temperature recording of fast-moving objects. An interesting demonstration of the uniformity of bore in steel instrument tubing will be given under the microscope.

New water-level indicators, high and low-water alarms, steam traps of improved design in operation, and a new expansion joint under accelerated test are a few of the attractions. The exhibits of piping and fittings, developed to meet the present demands of severe service, will be of special interest to engineers engaged in power plant design.

Sharples Solvents Will Move Plant to Wyandotte

The Sharples Solvents Corp. announces that it will move its manufacturing establishment from its present location in Belle, W. Va., to Wyandotte, Mich. This move will bring the Sharples plant closer to the principal consuming markets for its products.

In preparation for the change, ample stocks of Sharples products have been provided so that deliveries to consumers may continue without interruption from the present location until the new plant gets into operation shortly after the first of the year.

Engineers Week Designated For Chicago Exposition

The story of epochal discoveries in chemistry, their role in transforming living conditions in the past hundred years and the development of the chemical industry will be featured in exhibits in the Hall of Science of Chicago's 1933 World's Fair—A Century of Progress Exposition.

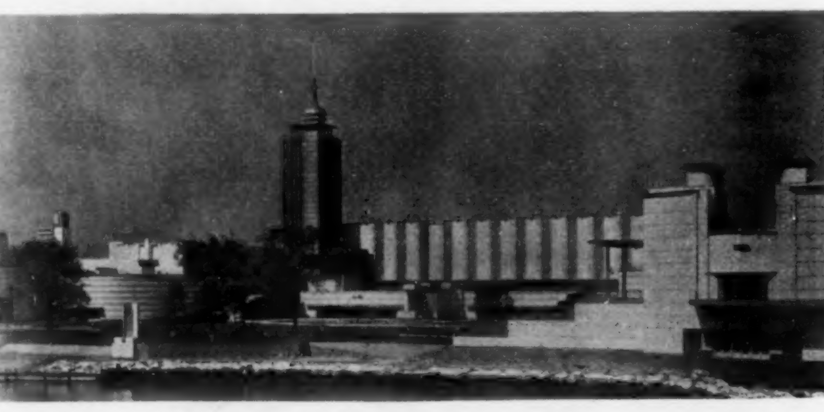
The basic theme of the Exposition will be dramatized in the great hall of the Hall of Science—a room 260 ft. long, 60 ft. wide and 50 ft. high, with a balcony fringing the west wall. The theme is this: that industries which in the past century have improved man's living conditions to a revolutionary degree owe their existence and present development to the basic sciences. Thus chemistry, physics, geology, biology, astronomy and mathematics will be presented by means of interesting exhibits in this room.

In other areas of the building, exhibits by manufacturers of scientific equipment, supplies, chemicals, laboratory machines and instruments of all kinds will be displayed.

Exhibits of chemistry will be twofold—the scientific displays sponsored by the Exposition itself and exhibits by leading chemical companies and firms related in the field of their products and service.

The exposition will open on June 1, 1933, and will continue through October. The week beginning June 25 has been designated as "Engineers Week." Programs are being formulated for that week which will be designed to interest all the engineering societies of this country.

The American Ceramic Society has scheduled its summer meeting for that week and the American Society for the Advancement of Science will be in session from June 19 to June 30.



The Hall of Science of a Century of Progress

This structure, 700 by 400 ft., is shaped like a U and encloses on three sides a court capable of accommodating 80,000 persons. At one corner rises a 176-ft. tower equipped with a carillon. It was dedicated June 1. Exactly one year later the science exhibits will be officially started by the light of the star Arcturus, focused by means of a telescope upon a photo-electric cell. Arcturus is forty light years distant, so that the impulse which starts the science exhibits in 1933 left Arcturus in 1893, at the time of Chicago's first World's Fair.

NEWS FROM WASHINGTON

By PAUL WOOTON
Washington Correspondent of Chem. & Met.

CANADA'S new tariff, effective October 13, bears down heavier on chemicals than on any other schedule. Many of the leading imports from the United States that formerly were on the free list now must pay duties ranging from 10 per cent to 25 per cent and generally speaking, Great Britain still has the advantage of a free market. But there are exceptions such as cellulose products, paints and varnishes which apparently have not been disturbed.

A duty of 10 per cent has been levied on aniline and coal tar dyes, of which imports from the United States reached nearly $1,000,000 last year against imports from Great Britain of $134,000. Nitrate of soda becomes dutiable at 20 per cent with imports from the United States running $500,000 and close to zero from Britain. Calcium chloride for road-treating must pay a duty of 15 per cent with imports of $460,000 from United States, $500 from Britain. The duty on zinc oxide has been raised from 5 per cent to 15 per cent against the United States, with British free. Imports from the United States last year totaled $400,000; from the United Kingdom, $125,000. The duty on alum cake has been raised from 10 per cent to 15 per cent, with imports of $480,000 from the United States, $34,000 from Great Britain. The duty of 20 per cent on stearic acid remains unchanged but the duty of 12½ per cent against Britain has been removed. On phosphoric acid and acids not now produced in Canada the duty has been raised from 22½ per cent to 25 per cent and imports from Great Britain, formerly dutiable at 15 per cent now are duty-free.

The new schedule of general rates, which apply to the United States, and the British preferential rates, with a comparison showing the old rates, follows:

New Canadian Tariff on Chemicals and Related Products Which Became Effective on Oct. 13

Commodity	General Rates New	General Rates Old	British Preferential New	British Preferential Old
Plain basic photographic paper, baryta coated, adapted for use exclusively in manufacturing albumenized or sensitized photographic paper	15%	Free	No change	Free
Roofing and shingles of saturated felt	No change	35%	Free	15%
Waxed stencil paper for use on duplicating machines	No change	35%	10%	22½%
Chemical compounds composed of one or more acids or salts soluble in water adapted for dyeing or tanning	10%	Free	Free	Free
Aniline and coal tar dyes soluble in water in bulk or packages of not less than 1 lb.	10%	Free	Free	Free
Bacteriological products or serum for subcutaneous injection	20%	Free	Free	Free
Blood albumen	No change	10%	Free	5%
Bisulphate of soda or nitre cake	20%	Free	Free	Free
Calcium chloride not in solution for road-treating purposes	15%	Free	Free	Free
Xanthates, cresylic acid and compounds of cresylic acid used in concentrate ores, metals and minerals	15%	Free	Free	Free
Ethylene glycol, for manufacture of anti-freeze compounds	15%	Free	Free	Free
Sal ammoniac and nitrate of ammonia	25%	Free	Free	Free
Oxide of cobalt	10%	Free	Free	Free
Bichloride of tin and tin crystals	10%	Free	Free	Free
Sulphate of copper	10%	Free	Free	Free
Sulphate of iron	10%	Free	Free	Free
Cream of tartar in crystals and tartaric acid crystals	10%	Free	Free	Free
Phosphorous and compounds not otherwise provided for	20%	Free	Free	Free
Oxalic acid	20%	Free	Free	Free
Oxide of tin or of copper	15%	Free	Free	Free
Sulphate of zinc and chloride of zinc	20%	Free	Free	Free
All chemicals and drugs when of a kind not produced in Canada which were, on Aug. 20, 1932 dutiable at rates of 15% and 25% under item 711	25%	Free	Free	Free
Peroxide of soda; silicate of soda in crystals or in solution; bichromate of soda; nitrate of soda or cubic nitre; sulphide of sodium; nitrite of soda; arseniate; binarseniate, chlorate, bisulphite and stannate of soda; prussiate of soda and sulphite of soda	20%	Free	Free	Free
Chloride of aluminum or chloralum	10%	Free	Free	Free
Bichromate of potash, crude, red, and yellow prussiate of potash	15%	Free	Free	Free
Sulphate of alumina or alum cake; and alum in bulk, ground or unground but not calcined	15%	10%	Free	Free
Stearic acid, n. o. p.	No change	20%	Free	12½%
Acids, n. o. p. of a kind not produced in Canada	25%	22½%	Free	15%
Phosphoric acid	25%	22½%	Free	15%
Nitric acid not including glass containers, when in packages weighing not more than 100 lb.	No change	22½%	Free	15%
Litharge, when imported by manufacturers of electric storage batteries for manufacture of storage battery plates (new class)	Free	Free	Free	Free
Other litharge	15%	Free	Free	Free
Dry red lead and orange mineral; zinc oxide such as zinc white and lithopone	15%	5%	Free	Free
Ochers, ochrey earths, siennas and umbers	15%	15%	5%	10%
Varnishes, lacquers, japans, Japan driers, liquid driers, and oil finish, n. o. p.	20c. gal. 30%	22½% and 20c. gal.	No change	15% and 20c. gal.
Putty of all kinds	27½%	25%	17½%	17½%
Gums, viz; amber, Arabic, Australian, copal, damar, elemi, kaurie, mastic, sandarac, Senegal, tragacanth, gedda, and barberry; gum chicle or sappatogum, crude; lac crude, seed, button, stick and shell; ambergris; Pontianac	15%	Free	Free	Free
Printing ink	25%	20%	12½%	12½%
Rotogravure ink	20%	20%	12½%	12½%
Essential oils n. o. p., including bay oil, otto of limes, and peppermint oil	7½%	7½%	Free	5%
Crude petroleum not in its natural state .750 specific gravity or heavier at 60 degrees temperature when imported by refiners, per gal.	1½c.	3/10c.	½c.	½c.
Cottonseed and crude cottonseed oil, when imported by manufacturers of cottonseed meal and refined cottonseed oil	10%	Free	Free	Free
Sulphuric and muriatic acid, not including glass containers, when in packages weighing not more than 100 lbs.	No change	per 100 lbs. 25c.	Free	Free
Acid phosphate, not medicinal	25%	20%	Free	12½%
Non-alcoholic preparations or chemicals used for disinfecting, dipping or spraying, when in packages not exceeding 3 lbs. each, in weight including weight of package	No change	25%	5%	15%
Sulphuric ether and chloroform	25%	25%	Free	15%
Soap, common or laundry, per 100 lbs.	$1.50	$1.00	50c.	65c.
Castile soap, per lb.	2c.	2c.	Free	1c.
Glue, liquid, powdered, or sheet, and gelatine n. o. p.	25% plus 5c lb.	27½% plus 3c. lb.	No change	17½% 2c. lb.
Vegetable glue	35%	27½%	10%	17½%
Gelatine, edible	35%	27½%	10%	17½%
Mucilage, caseine and adhesive paste	No change	27½% plus 3c. lb.	No change	17½% 2c. lb.
Perfumery, including toilet preparations, non-alcoholic, viz; hair, oils, tooth and other powders and washes, pomatums, pastes, and all other perfumed preparations n. o. p. for hair, mouth and skin	40%	32½%	20%	25%
Surgical dressings	35%	20%	12½%	12½%
Ultramarine blue, dry or in pulp, whiting, or whitening, Paris white, and gilders' whiting; blanc fixe; satin white	10%	Free	Free	Free

NEWS FROM ABROAD

By Special Correspondents of Chem. & Met. at London, Berlin and Paris

London

ALTHOUGH there is no definite evidence of increased industrial production or consumption, the outlook for British Chemical Industry has undoubtedly taken a turn for the better, partly because hand to mouth buying has ceased and manufacturers are again making purchases for stock. As a result of the increase in the price of raw materials, industrial concerns are more likely to present balance sheets sufficiently favorable to warrant the payment of dividends on a scale which would have been regarded as unlikely some months ago. Thus Imperial Chemical Industries' interim dividend was 2½ per cent as against 1½ per cent last year, and in consequence the market price of the shares has nearly doubled and a 6 per cent or even a 7 per cent dividend for the whole year (as compared with 5 per cent last year) is considered possible.

Representatives of the Association of British Chemical Manufacturers have presented their report on the contacts made in Canada and the United States on the occasion of the Ottawa Conference. It was well that an understanding had virtually been reached in regard to preferences and markets, before the Conference opened, because as it turned out, there was no opportunity for effective consultation while the Conference was sitting. Even the official advisers to the British Government delegation appeared there mainly on the offchance that their services might be needed rather than as an integral part of the staff. The various technical and commercial representatives of industry who made the trip were hardly consulted, but all seem to have been delighted with the warmth of their welcome and the opportunity given for frank discussion.

Aluminum Foil for Heat-Insulation

The use of aluminum foil as a heat-insulating material is arousing interest, and tests made at the National Physical Laboratory on steel pipes at high temperature with a 2-inch layer of "Alfol," gave an efficiency of about 94 per cent. The foil is highly polished and approximately .0003-inch thick embossed with a diamond pattern to facilitate the subsequent crumpling operation, and there seems to be a future for this material, particularly for refrigeration work and road transport. "Alfol" has a competitor, however, in glass silk which is made by Chance Brothers, and which is said to give up to 97 per cent efficiency, while having similar advantages as regards freedom from bacteria and other deterioration. Glass silk is applied in the form of mattresses, or in made-up ribbon wound round pipework, and has proved very successful at some of the new super power stations.

Voltalyte is the name given to a new organic liquid compound for filling accumulators, and its cost of manufacture is given as 10 cents per imperial gallon, which is about half that of accumulator acid. Voltalyte is said to enable accumulators to be charged and discharged more rapidly and to prevent all danger of sulphation while also giving a lower internal resistance, and reducing evaporation and corrosion to terminals, etc. It has given excellent results with worn out accumulators, which after a few charges appear to take on a fresh lease of life.

Rust-proofing compounds frequently make their appearance, and the latest is "Edgerol," of German origin, which is said to combine with the rust as well as with the iron to form waterproof oxide compounds, which adhere firmly, and not only prevent further corrosion, but enable lacquer and paint to adhere satisfactorily. "Edgerol" can be applied by dipping or by spraying and appears to present advantages over other methods.

Emulsions play an increasingly important part in every day life, and in this connection an interesting booklet has been issued by the Amoa Chemical Company, Limited, which has evolved a series of preparations that enable industrial concerns to save time and trouble. The "Amoa" emulsions prove particularly effective in the textile trade for jute, rayon, cotton and wool, and enable heavy or light mineral oils, fats, waxes, bitumens, creosote, etc., to be emulsified for a variety of purposes.

The process of platinum plating introduced by Johnson Matthey & Company, Ltd., is making headway, not only for deposition on silver ware, thereby avoiding trouble from tarnishing and cost of periodic cleaning and polishing, but also for scientific, optical and surgical instruments, and for the highest class of automobile fittings and door furniture. The cost is about $3 per square foot for parts subject to rough usage, and about $1 per square foot for such articles as photograph frames, this being the actual value of the platinum, and the cost of plating, which is not included in this figure, is about the same as for depositing silver. The technique of using the new platinum plating salt has been carefully worked out, and the current density used is between 6 and 8 amperes per square foot, with a voltage of between 2 and 10 according to the size of the article being plated. Three ounces of plating salt costing about $70 are required for each imperial gallon of plating solution, so that the initial outlay is fairly heavy, but it is not unlikely that platinum plating can advantageously be considered for chemical work.

A past president of the Society of Chemical Industry passed away a few days ago, in the person of John Gray, a former director and vice-president of Lever Brothers, Limited. Mr. Gray did pioneer work in the planning of Port Sunlight and also served the society truly and well. His abilities and ideals are worthily carried on by his son, George Gray, a vice-president of the society and of the Institution of Chemical Engineers.

Berlin

THE director of the Institute of Economic Research, Professor Wagemann, who has been adviser in the recent government economic decrees, has said "If no fundamental action is taken to increase volume of business through employment and credit expansion, we shall have to count in the future on a further depression in all important activities." This means that if plans for increasing business volume as outlined by Von Papen, are successful, we can count on an improvement in the near future. A slight encouragement is offered by stocks, which have not increased since the beginning of the year, and which are now in step with production. In certain cases production is even less than consumption, so that a slight reduction of stocks has been possible. The nitrogen market has been surprisingly revived: orders in July and August exceeded by 60 per cent those of the previous year. Rating demand at 100 for 1929, it represented 93 per cent in 1930, 51 per cent in 1931 and 83 per cent in 1932. Stabilization is also evident on the market for resin and shellac, and inorganic pigments.

The new fuel agreement seems to have brought some stability into the gasoline market. In 1931, the mistake was made of making price agreements with the intention of apportioning the German market later. This caused a rush for markets in order to justify a demand for a great share of the apportionment. This time the quotas were fixed in the first place; price arrangements have not yet been settled. Gasoline prices have gone down considerably, but because the addition of alcohol is still obligatory, the total price for fuel is still as high as in 1927. This would still have an adverse effect because

many automobiles are being put in storage for the sake of economy.

Foodstuffs produced from wood are to be manufactured on a commercial scale in the near future. The German Bergin A.G. for Coal and Petroleum Chemistry has reorganized under the name of Deutsche Bergin A.G. für Holzhydrolyse. The latter is expanding its factory in Mannheim for the purpose of carrying on a constant production of wood sugar. The latter will probably not exceed several thousand tons a year right away, but a gradual increase is anticipated. The domestic significance of the plant is that it will decrease the national import of oats. An agreement has been made with Russia for the erection of a large plant.

New Lacquer Material in Use

The Tornesch plant, whose process for converting wood into alcohol was described here recently, is now marketing a material for use in the lacquer industry, in the form "Tornesit." The latter is a chlorinated latex produced at 80 deg. C., and has very interesting properties. A 65 per cent benzol solution forms a viscous mass, which on agitation will dissolve more Tornesit and yield a plastic mixture. Tornesit is also soluble in linseed and tung oil, but practically insoluble in water, gasoline and mineral oils. Even a high percentage of Tornesit in benzol yields a solution that is still mobile and hence can be used readily for coating. Without the use of plasticizers, Tornesit films are very strong but brittle.

The new Ilseder coke plant in Westphalia consists of 62 interconnected ovens which treat 1,200 tons of dry coal in 20 hours. Its advantage is that it supplies the metallurgical plant there with coke oven gas and can send any excess to the long distance gas networks. The sulphur is removed from the high sulphur gas according to the Thylox process of the American Koppers Company, in which a weak alkaline solution of sulphur arsenic compounds removes the entire sulphur. This washing solution is regenerated by oxidation and the sulphur is sold as a paste for insecticides.

The necessity of dehydrating ethyl alcohol on a large scale, for use in combustion motors, has been achieved by the use of an azeotropic distillation process in which benzol or gasoline is added to form a ternary system with alcohol and water. In the upper part of the column a ternary mixture of alcohol, benzol and water, boiling lower than alcohol, is distilled off, whereas in the column itself, absolute alcohol remains. The ternary mixture is then allowed to settle off into layers, which in turn are used in the process again. This process, which has already found considerable use, has been improved by the use of trichlorethylene instead of the benzol or gasoline. The state monopoly is using the process in six of its plants and obtaining a daily yield of 340,000 liters of absolute alcohol. The trichlorethylene is being made by the firm of Dr. Alexander Wacker G.m.b.H., in München.

Paris

THE economic situation has not changed over the summer, mainly because everything was at a low level to begin with and the unfavorable trade balance has not been improved. Among the large industries, those allied with public utility such as the electrical and gas industries have suffered least from this year's crisis. If they have not been able to increase their business, they have at least maintained the figures of the past and the corresponding dividends. One difficulty in the gas industry, which is otherwise favored by civic regulations, is the disposal of the byproduct coke. This figured largely in the Congress of the Gas Industry held in Paris in June, which advised the use of coke as an industrial and central station fuel, wherever particularly advantageous conditions prevailed.

The production of tar in the gas industry proper has not receded, but in the metallurgical industries, it has dropped corresponding to the low activity there. The total tar production in France for 1931 was 560,000 tons against 595,000 tons in 1930, but its use in road-building increased by 20,000 tons to 470,000 tons in 1931.

The potash industry in Alsace has also undergone a great decline; against 500,000 tons of pure potash in 1930, the output was 350,000 tons in 1931. For 1932 the output is being maintained within 10 per cent of this rate. The decline is due mainly to export, particularly to the United States, while the domestic consumption has remained constant. The sales organization for potash, Sociéte Commerciale de Potasse d'Alsace, reports that the industry at Rouen has maintained its production of potassium sulphate at 120 tons a day. This product is obtained by the action of sulphuric acid and potassium chloride, with hydrochloric acid as byproduct.

The superphosphate industry has also seen a strong reduction in production, which dropped from 2,000,000 tons in 1930 to 1,500,000 tons in 1931, and at such reduced prices that the plants at Orléans, Avignon, and Pompéan, have been closed. The large St. Gobain and Kuhlmann Trusts nevertheless continue their production in spite of the unfavorable prices, which they can do because other production lines compensate for the poor showing of superphosphate. The export of the latter has also declined severely: although it amounted to 280,000 tons in 1927, it was less than 85,000 tons in 1931, as a result of trade barriers in foreign countries. The drop in Sterling has, of course, reduced the export to the extent of 12,000 tons in 1931 against 42,000 tons in 1930.

Patent Exchange Aimed At Trade Barriers

Development of a plan for the international exchange of patent rights on a sale or leasing basis is embodied in the newly-established Amerika-Interessen, Inc., Chrysler Bldg., New York, under B. Lilienthal, president. The organization, founded in Germany in 1931 to further German-American trade relations, hopes to overcome to some extent the handicaps of international tariffs and other trade barriers by sale or release of patents, manufacturing licenses, and agreements by firms who now find their foreign markets cut off.

According to Mr. Lilienthal, European manufacturers have reacted favorably to the proposal, and offices are now established in Berlin, London and Paris. The organization soon received numerous commitments on patents and processes from leading German industries and comparable interest has been shown in France and England.

The plan as outlined is the first organized attempt to promote patent interchange, according to domestic exporters. However, interest in the subject has been keen in this country in the last year, especially when American producers found themselves suddenly excluded from foreign markets by protective action.

Among the directors of the parent organization in Berlin are Karl von Lewinski, former German Consul General in New York; Dr. K. O. Bertling, director of the Amerika-Institut, Berlin; and H. E. Muencks, director of the German-American Trade Association.

Hercules Develops New Pale Wood Rosins

The production of new wood rosins of the grades M and N is announced by the Naval Stores Department, Hercules Powder Company. The new rosins are unbleached and experiment has shown, it is stated, that they will bleach with heat into the paler shades.

A new process developed at the company's Brunswick, Ga., plant makes possible the production of a complete line of wood rosin grades which will extend, upon bleaching, into the palest grades now in demand, it is stated by Hercules authorities.

Potash Mining Extended In New Mexico

Mining operations in the potash section of New Mexico is being extended. The U. S. Potash Co. is preparing to sink a second shaft on its property near Carlsbad. The extent of the deposit has been borne out by tests. The New Mexico Potash and Chemical Co. also is conducting test drillings and may install mining equipment in the near future.

NAMES IN THE NEWS

Daniel S. Dinsmoor, of the Monsanto Chemical Works, is spending a year at the British subsidiary of his company, in Ruabon, Wales, as technical adviser and organizer.

Frank J. Oliver, Jr., formerly on the editorial staff of *American Machinist* and *Product Engineering*, has been appointed industrial co-ordinator of the College of Engineering, University of Detroit. His work will include the placement of chemical engineering students in the process industries or their laboratories.

Richard Koch, since 1928 a member of the editorial staff of *Chem. & Met.*, has resigned to join the technical staff of the newly established Amerika-Interessen, Inc., of New York. After graduating from Yale in 1927, Mr. Koch attended the University of Munich. He has made a close study of European developments in chemical engineering and has written or translated a number of articles and books on this subject.

W. H. Scott, who has been with the Duriron Co. for 13 years, has been appointed general sales manager with offices at Dayton, Ohio.

James Coull has been appointed assistant professor of chemical engineering at Cooper Union, New York, N. Y. Dr. Coull studied at the University of Aberdeen, Scotland, and pursued his advance education in Massachusetts Institute of Technology and Columbia University. He has also acted as industrial consultant in rubber technology.

Eugene R. Manning, formerly with the Connecticut State Water Commission and active at the Sterling Chemistry Laboratory, Yale University, has accepted a position as head of the Department of Textile Chemistry at Clemson Agricultural & Mechanical College, Clemson, S. C.

R. V. Kleinschmidt, formerly assistant manager of the process section of du Pont Ammonia Co., has rejoined the staff of Arthur D. Little, Inc., Cambridge, Mass.

GEORGE OENSLAGER

George Oenslager, research chemist, B. F. Goodrich Rubber Co., has been selected to receive the Perkin Medal, the presentation to take place on January 6. The award is based on valuable work on organic rubber accelerators.

T. H. Murphy has returned to his home in Yonkers, N. Y., after spending a year as general administrator to the sugar cane industries of G. Melendez in El Salvador.

Arthur Wright and George W. O'Keeffe have organized the Arthur Wright & Associates, equipment and process engineers, in New York. They will render an engineering service on filtration problems in addition to acting as general sales representative of Filtration Engineers, Inc., Newark, N. J.

CALENDAR

American Institute of Chemical Engineers, annual meeting, Washington, D. C., Dec. 7-9.

American Chemical Society, 85th meeting, Washington, D. C., March 26—April 1.

American Petroleum Institute, 13th annual meeting, Houston, Tex., Nov. 15-17.

Electrochemical Society, spring meeting, Montreal, May 11-13.

Fourteenth Exposition of Chemical Industries, New York, week of Dec. 4-9, 1933.

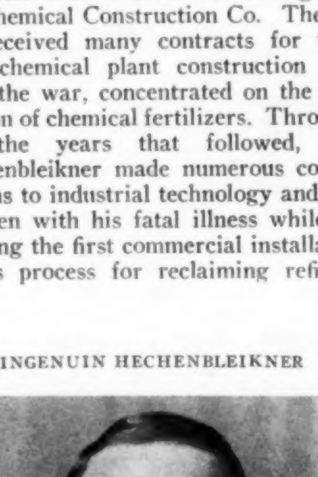
OBITUARY

Oliver J. Teeple, Jr., director of the smokeless powder division of E. I. du Pont de Nemours & Co., died on Aug. 16 after an illness of several years. He was a graduate of New York University.

Marion H. Foss, consulting engineer for the United Chemical & Organic Products Co., a subsidiary of Wilson & Co., meat packers, died on Aug. 28, at the age of 47.

Ingenuin Hechenbleikner, vice-president of the Chemical Construction Co., Charlotte, N. C., died on Sept. 15, after an operation for appendicitis. Mr. Hechenbleikner was born in 1883 in Innsbruk, Austria, and had a brilliant early career in chemistry and in the Austrian Army. He came to America at the behest of James B. Duke, in 1911, for the introduction of an atmospheric nitrogen process, which he placed in operation at Nitrolee, S. C. Later he designed and constructed a plant at Mount Holly, N. C., for producing electric furnace phosphoric acid. In 1914, Mr. Hechenbleikner joined with P. S. Gilchrist and T. C. Oliver to organize the Chemical Construction Co. The latter received many contracts for wartime chemical plant construction and, after the war, concentrated on the production of chemical fertilizers. Throughout the years that followed, Mr. Hechenbleikner made numerous contributions to industrial technology and was stricken with his fatal illness while inspecting the first commercial installation of his process for reclaiming refinery acid.

INGENUIN HECHENBLEIKNER



Seasonal Trends and Surplus Stocks Influence Production Schedules

REPORTS of increased activities in several industries which consume chemicals in a large way have coincided in time with the period when seasonal influences might be expected to bring about improvement. Production figures, especially for divisions of the year, are not available for the chemical and chemical-consuming industries in general. In some cases, however, such breakdowns are possible and the accompanying table records the rate of production or consumption for the lines specified according to the quarters of the years.

Variations in quarterly totals make it evident that production can not be sustained on an even basis throughout the year without stock accumulations. For instance production of denatured alcohol, because of anti-freeze requirements, reaches its peak in the last quarter of the year. Sales of paint, varnish, and lacquer are largest in the second quarter of the year. In fact these sales during April and May in recent years have averaged so close to 20 per cent of the year's total that it seems safe to predict the year's sales if the early months' totals are known.

The influence of stocks on productive activities has just been illustrated in the case of rayon. Following a shutdown of plants for a month or more, the holdings of producers were quickly absorbed by early buying for Fall needs and producers since then have worked at capacity without being able to catch up with orders.

In the accompanying table of stocks and shipments, it will be noted that in some cases average stocks carried by manufacturers represent less than one month's consuming requirements. Stocks of pneumatic tires gained appreciably in 1929 but have been steadily reduced since then. The position of stocks at the close of last June was regarded as one of the factors which were favorable to enlarged production in the latter part of the year.

Stocks and Shipments

	Stocks Monthly Average	Shipments Monthly Average	Stocks Monthly Average	Shipments Monthly Average
	Alcohol Denatured 1,000 Wne Gal.		**Explosives**	
1927	2,000	7,705	17,827	33,837
1928	1,458	8,305	17,644	33,039
1929	1,999	9,531	18,097	36,571
1930	2,656	7,407	17,779	31,741
1931	3,187	6,959	20,139	25,864
1932*	2,280	3,853	17,904	16,597
	Methanol, Synthetic 1,000 Gal.		**Wood Pulp Ton**	
1927	......	......	230,924	215,181
1928	......	......	195,787	215,724
1929	......	......	167,912	228,512
1930	894	584	148,760	208,899
1931	2,313	519	122,903	172,700
1932*	2,397	438	134,407	163,883
	Glass Containers 1,000 Gross		**Pneumatic Tires 1,000**	
1927	6,066	2,132	8,272	4,018
1928	6,297	2,331	8,808	4,651
1929	6,489	2,429	11,227	4,627
1930	6,635	2,248	9,167	3,576
1931	5,877	2,092	7,351	3,337
1932*	5,639	1,845	6,775	3,611

* Figures for 1932 are for first six months.

Quarterly Production and Consumption in Chemical and Related Industries

	1927		1928		1929		1930		1931		1932
	Production	Per Cent of Year's Total	Production	Per Cent of Year's Total	Production	Per Cent of Year's Total	Production	Per Cent of Year's Total	Production	Per Cent of Year's Total	Production
Alcohol, denatured, 1,000 wine gal.											
First quarter	17,183	18.5	16,518	16.5	22,790	19.9	17,764	19.4	13,768	16.7	13,746
Second quarter	21,047	22.7	21,501	21.6	23,200	20.2	19,375	21.2	18,315	22.4	14,257
Third quarter	23,407	25.3	26,878	27.1	30,914	27.0	21,017	23.0	19,520	24.0	......
Fourth quarter	31,032	33.5	34,708	34.8	37,609	32.9	33,348	36.4	30,036	36.9	......
Explosives, 1,000 lb.											
First quarter	101,419	24.8	91,503	23.0	103,473	23.6	95,451	25.0	82,168	26.7	53,331
Second quarter	100,250	24.5	97,628	24.6	107,695	24.5	100,660	26.3	81,221	26.4	48,096
Third quarter	104,116	25.5	100,486	25.3	118,359	27.0	97,666	25.6	76,214	24.7	......
Fourth quarter	103,103	25.2	107,802	27.1	109,257	24.9	88,421	23.1	68,386	22.2	......
Glass containers, 1,000 gross											
First quarter	6,208	24.4	6,825	24.0	7,255	24.7	6,937	25.4	5,521	22.4	5,040
Second quarter	6,679	26.3	7,677	27.0	7,812	26.7	7,580	27.8	7,380	29.9	5,999
Third quarter	6,225	24.5	7,382	26.0	7,407	25.3	6,867	25.2	6,455	26.1	......
Fourth quarter	6,292	24.8	6,505	23.0	6,840	23.2	5,896	21.6	5,328	21.6	......
Plate Glass, 1,000 sq.ft.											
First quarter	29,915	26.9	31,465	24.1	35,859	23.8	21,238	21.9	26,796	30.8	16,341
Second quarter	27,916	25.0	32,796	25.1	37,615	25.0	33,129	34.2	27,194	31.3	12,951
Third quarter	28,837	25.9	33,022	25.3	41,790	27.8	21,828	22.6	18,326	21.1	......
Fourth quarter	24,722	22.2	33,365	25.5	35,234	23.4	20,627	21.3	14,599	16.8	......
Pyroxylin spread, 1,000 lb.											
First quarter	10,879	25.5	14,575	23.9	18,091	32.9	14,076	32.6	9,690	26.7	7,078
Second quarter	11,771	27.5	15,238	24.9	15,414	28.0	12,424	28.7	12,334	34.0	6,117
Third quarter	10,427	24.4	15,480	25.3	12,437	22.6	9,066	21.0	8,110	22.3	......
Fourth quarter	9,636	22.6	15,841	25.9	9,118	16.5	7,647	17.7	6,175	17.0	......
Wood pulp, ton											
First quarter	671,634	25.9	647,618	25.1	682,054	24.8	698,982	27.3	550,806	26.0	547,182
Second quarter	648,660	25.1	651,164	25.2	701,036	25.5	674,258	26.3	548,476	25.9	470,680
Third quarter	628,902	24.3	624,416	24.2	678,190	24.7	602,472	23.6	513,700	24.3	......
Fourth quarter	638,796	24.7	659,932	25.5	687,766	25.0	585,156	22.8	503,440	23.8	......
						Consumption					
Cotton, in textiles, 1,000 bales											
First quarter	1,886	25.5	1,740	26.4	1,895	26.8	1,578	29.4	1,374	25.2	1,374
Second quarter	1,908	25.8	1,612	24.6	1,870	26.5	1,410	26.2	1,428	26.2	1,020
Third quarter	1,833	24.7	1,458	22.2	1,652	23.4	1,125	20.9	1,341	24.6	......
Fourth quarter	1,780	24.0	1,760	26.8	1,644	23.3	1,264	23.5	1,307	24.0	......
Silk, bales											
First quarter	140,409	26.5	155,110	27.2	153,455	24.8	158,398	27.2	165,535	27.8	151,463
Second quarter	134,651	24.4	133,676	23.4	149,480	24.1	111,803	19.2	128,590	21.6	116,168
Third quarter	138,188	25.1	139,549	24.4	164,602	26.5	137,331	23.6	145,019	24.4	......
Fourth quarter	138,131	25.0	142,675	25.0	152,210	24.6	174,694	30.0	155,745	26.2	......
Wool, 1,000 lb.											
First quarter	146,589	26.5	140,168	26.0	149,979	25.6	119,152	27.7	112,649	21.9	98,063
Second quarter	133,315	24.2	124,048	23.1	142,036	24.3	102,207	23.7	138,481	27.0	55,406
Third quarter	134,490	24.4	126,694	23.5	149,695	25.5	106,526	24.8	152,574	29.7	......
Fourth quarter	137,135	24.9	147,444	27.4	143,848	24.6	102,219	23.8	110,039	21.4	......
Paint, varnish, and lacquer, $1,000											
First quarter	......	....	97,202	23.1	101,487	23.3	87,835	25.2	67,988	24.4	51,255
Second quarter	......	....	125,115	29.7	130,687	30.0	112,012	32.2	93,857	33.7	67,389
Third quarter	......	....	106,541	25.3	116,641	26.8	85,379	24.5	65,877	23.7	......
Fourth quarter	......	....	91,965	21.9	86,287	19.9	63,174	18.1	50,720	18.2	......
Rubber, crude, ton											
First quarter	88,016	26.4	93,414	23.5	116,394	27.5	94,778	27.7	82,930	25.8	78,938
Second quarter	93,838	28.1	97,003	24.4	125,984	29.8	103,268	30.1	100,330	31.3	86,725
Third quarter	80,904	24.2	108,193	27.3	103,056	24.4	78,299	22.8	76,508	23.8	......
Fourth quarter	71,068	21.3	98,595	24.8	77,391	18.3	66,464	19.4	61,299	19.1	......

CHEMICAL ECONOMICS

Chemical production further increased last month but many still operate on reduced schedules. Activity in textile industry more pronounced than in other lines which are consumers of chemicals

IMPROVED call for chemicals was again reported last month. Productive operations which were at a higher rate in August than in the preceding month were still further speeded up in September but the improvement was not large. Based on consumption of electrical energy the index number for chemical production in September was 110.7 compared with 110.1 for August and 109.1 for July. Several plants which had closed in the early summer months were reported to be still idle and in a few cases operating plants fell below the August rate of operation. The majority of plants, however, reported moderate gains and the increase in deliveries was said to have been larger than that for production.

Rayon plants have been working at close to capacity and in some cases have their outputs sold ahead for the remainder of this year. Producers are about four weeks behind with deliveries and some textile manufacturers have complained that their activity has been retarded because they could not get yarn deliveries in sufficient volume. Textile production, however, has shown a notable improvement and this industry appears to be leading all others as far as recent gains in rate of operation are concerned.

The automotive industry has remained quiet but promises a decided upturn in the last two months of the year. Stocks are reported to be close to 40 per cent below those of a year ago and for months, deliveries have been running ahead of production. It is estimated that a new low for production will be reached in the present month but work on 1933 models will speed up the output in November and December.

Latest figures for production and consumption cover the month of August. The comparisons offered with the preceding month generally were favorable. Production of cold water paints and calcimines was considerably broadened. Sales of paints, varnish, and lacquers in August were valued at $16,014,028 in comparison with $14,430,122 for July. The following table gives other comparisons for July and August activities:

Production	1932 August	1932 July
Alcohol, ethyl 1,000 per gal.	12,200	11,908
Automobiles, No.	90,324	111,141
Byproduct coke, 1,000 tons	1,474	1,523
Explosives, 1,000 lb.	18,340	12,728
Glass containers, 1,000 gr.	1,660	1,667
Plate glass, 1,000 sq.ft.	1,773	2,734
Paints — Plastic, lb.	528,867	568,280
Calcimines, lb.	2,401,747	1,757,491
Cold water, lb.	890,359	729,253
Pyroxylin spread, lb.	1,958,900	1,474,016
Pine oil, gal.	189,132	201,608
Rosin, wood, bbl.	31,141	30,076
Turpentine, wood, bbl.	4,861	4,878
Rosin, gum, receipts, 3 ports bbl.	99,148	104,904
Turpentine, gum, receipts, 3 ports bbl.	27,770	29,723
Cottonseed oil, crude, 1,000 lb.	45,539	30,738
Cottonseed oil, refined 1,000 lb.	38,273	54,112
Rubber reclaimed, ton.	3,101	5,146
Consumption		
Cotton, in textiles, 1,000 bales	403	279
Wool, 1,000 lb.	41,361	26,719
Silk, bales	59,505	38,382
Rubber, tons	20,582	26,010
Paint, varnish and lacquer, value	$16,014,028	$14,430,122
Fertilizer, in South, 1,000 tons	40	14

The outstanding feature from the above comparison is found in the high rate of increase in consumption of cotton, wool, and silk. While rubber consumption was reduced, recent reports from rubber centers indicate that tire production will be much larger in October and it is evident that rubber is going into consumption in a larger way at present than was the case in August.

Deliveries of industrial alcohol also have gained in volume recently and the normal increase in production and shipments in the latter part of the year is expected to influence producers in November and December.

Prospects for Fourth Quarter

The outlook for maintaining textile production on a relatively high plane is regarded as favorable but is somewhat contingent upon the price position of basic raw materials. Private estimates place consumption of cotton by domestic mills in September at 467,000 bales which represents a marked gain over the Census Bureau figures for August and incidentally is higher than the consumption in September, 1931. As a result of questionnaires sent out by thirteen shippers advisory boards, a decline of 10.4 per cent in freight carloadings is indicated for the fourth quarter of this year as compared with the final quarter of 1931. The estimate places loadings of chemicals and explosives at 19,896 cars with 20,517 cars actually shipped in the final quarter of 1931. This decline of a little more than 3 per cent gives a relatively better outlook for chemicals than for general industry.

Estimates for carloads of other commodities for the period with comparisons for the last quarter of last year include: Salt 24,508 and 27,518; petroleum and products 457,825 and 472,713; automobiles and parts 49,107 and 54,469; fertilizers 27,634 and 34,087.

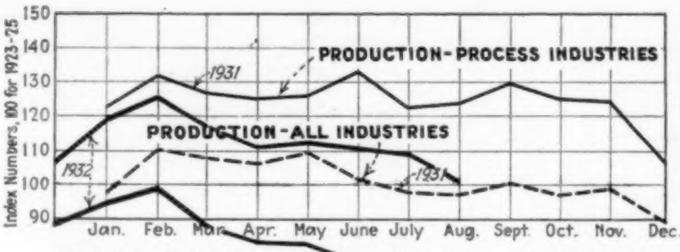
September tag sales in the sixteen tag sale States were slightly larger than the sales for September, 1931. In the Southern States an increase of about 7 per cent was noted, while the three Midwestern States combined showed an increase of about 3 per cent, National Fertilizer Association reports.

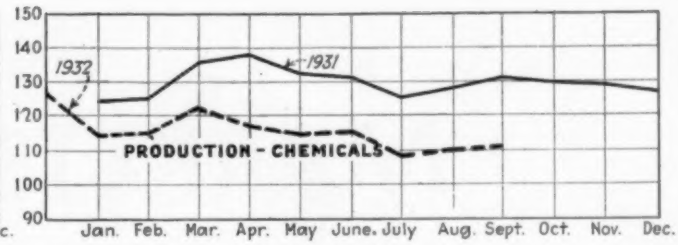
Total sales were 124,267 tons in sixteen States, compared with 117,220 tons during September, 1931, and 182,211 tons during the same time in 1930. Sales during Jan.-Sept. were 2,492,898 tons, or 61 per cent of 1931, when sales for this period were 4,063,011 tons.

Tag sales in Southern States were 97,376 tons, against 91,191 tons during September last year, and for the period Jan.-Sept. 2,401,292 tons, or 62 per cent of the 1931 sales, which totaled 3,867,671 tons.

Ordinarily only 3 per cent of Southern fertilizer sales take place during September.

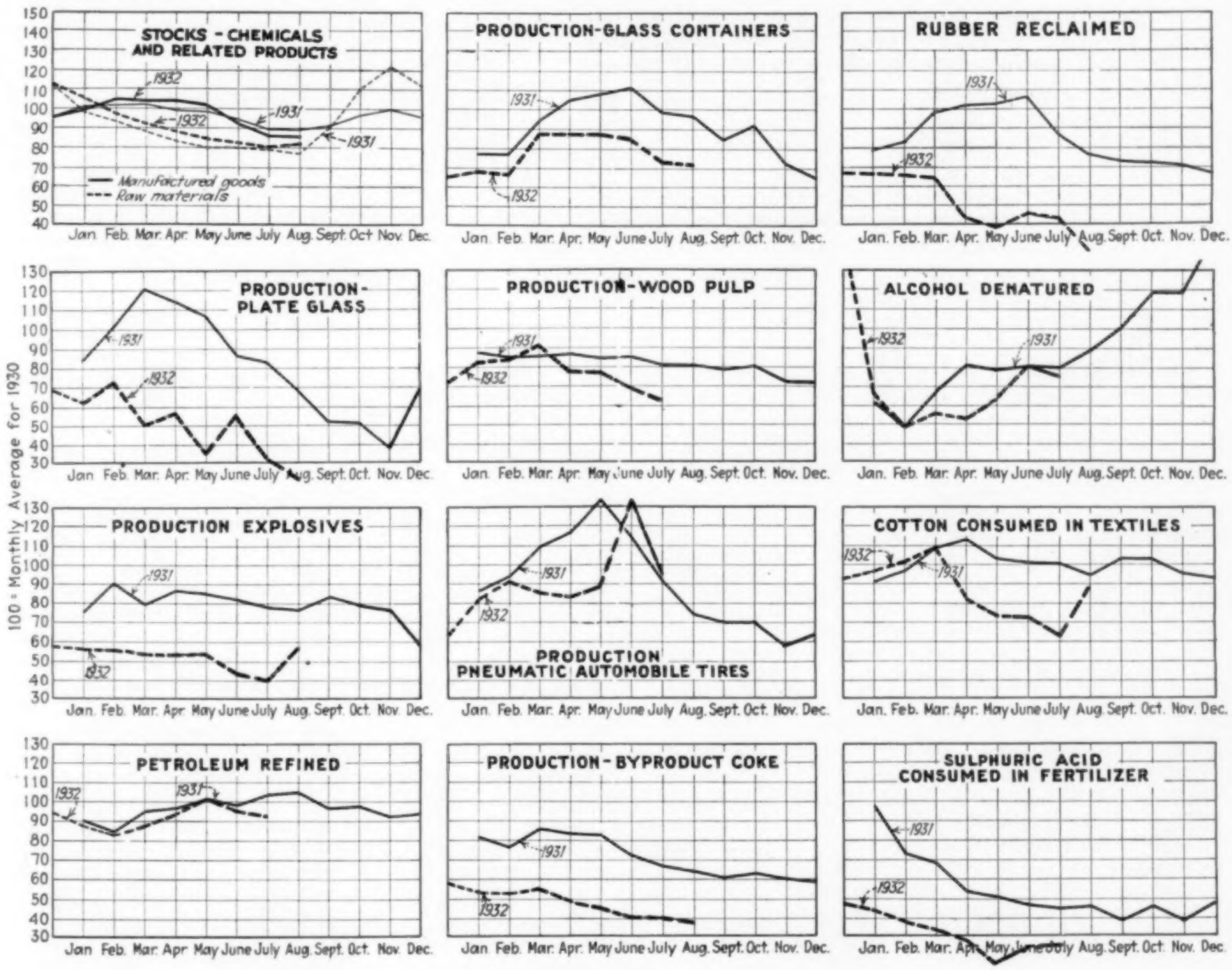
Foreign advices state that German nitrogen sales during July and August were reported to have increased 60 per cent over the corresponding period of last year.

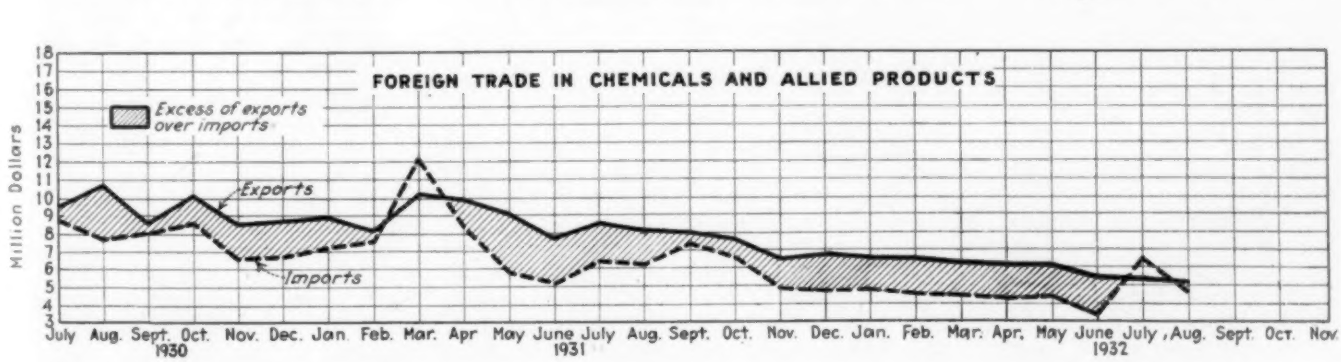




Based on electrical power consumption, data supplied by Electrical World

TRENDS OF PRODUCTION AND CONSUMPTION





MARKETS

Canadian tariffs on chemicals revised on Oct. 12 to favor trade with United Kingdom. Domestic markets feel wider call for chemical products with keener interest in contract prices for delivery over next year. Large arrivals of foreign iodine depress market and drastic price cut adversely affects progress of domestic trade

ANNOUNCEMENT on Oct. 12 that Canadian tariffs had been adjusted to favor trade with the United Kingdom and its possessions had been anticipated as the recent conference held in Ottawa had forecast such an outcome.

Important changes are made in the chemical schedule. Scores of chemicals and chemical compounds were formerly entered free under all tariffs. Under the new agreement duties ranging from 10 to 25 per cent have been imposed under the intermediate and general tariffs, leaving a wide margin of preference for empire products.

The commodities embraced within this wide classification include compounds for dyeing and tanning, aniline and coal-tar dyes, serums, blood albumen, nitre cake, calcium chloride for road uses, cresylic acid compounds, ethylene glycol for use in anti-freeze compounds, nitrate of ammonia, oxide of cobalt, tin crystals, blue vitriol, copperas, tartaric crystals, phosphorus and compounds, sulphate and chloride of zinc, bichromate and prussiate of potash, various sodium compounds, salt cake, chlor-alum and alum, phosphoric acid and 100-volume nitric, sulphuric and muriatic acids.

On chemicals such as formerly were dutiable the British preference has been enlarged.

Developments in domestic markets during the month were characterized by a freer movement of commodities to some of the consuming trades and by a keener interest in forthcoming contract prices for some of the larger tonnage chemicals. Consumers of chlorine are reported to have been influenced by the low prices quoted and are largely covered for the coming year and the market has assumed a quiet appearance.

Large Receipts of Iodine

Considerable interest has been aroused in iodine because imports in August amounted to 424,000 lb. compared with 278,000 lb. for the entire year of 1931. These receipts were followed by a drastic cut in prices. The situation is somewhat involved as domestic production has been increasing and the transference of unsold stocks from Chile to this country is hardly favorable to the development of home production especially at the relatively low prices now prevailing. The holding of large stocks in this country also forestalls any relief which might have been obtained through recourse to higher tariff protection.

Byproduct Sulphuric Acid Plant for Germany

A report from abroad states that a new zinc smelting and refining plant under consideration at the newly developed port of Madgeburg would permit up to 100,000 metric tons annual output of byproduct sulphuric acid. Among near-by potential consumers for this acid are the I. G. Farbenindustrie at Leuna and industries in Bitterfeld.

Tariff Hearing on Sperm Oil

Arguments favoring reduction in the present tariff duties on crude and refined sperm oil and spermaceti wax were heard on Sept. 20 by the Tariff Commission in its investigation of the cost of production at home and abroad.

Appearing in behalf of the Bureau of Raw Materials for American Vegetable Oils and Fats Industries, John B. Gordon, secretary, declared that a reduction in the present duty on crude sperm oil is not opposed by the American industry and if brought about might possibly lead to an increased revenue through increased imports.

He said that the only American producer of sperm oil in the United States is a subsidiary concern of a Canadian company and added that no domestic producer of animal or vegetable oils or fats can be injured by a reduction in the import duty because sperm oil is a liquid wax which cannot compete with any of the domestic grown animal oils or fats.

Others to testify in behalf of a reduction in the duty were Gilbert P. Smith, president, Cook Swan Oil Corporation and Frederick Shelton, attorney, representing Strohmeyer & Arpe and Smith & Nichols, importers.

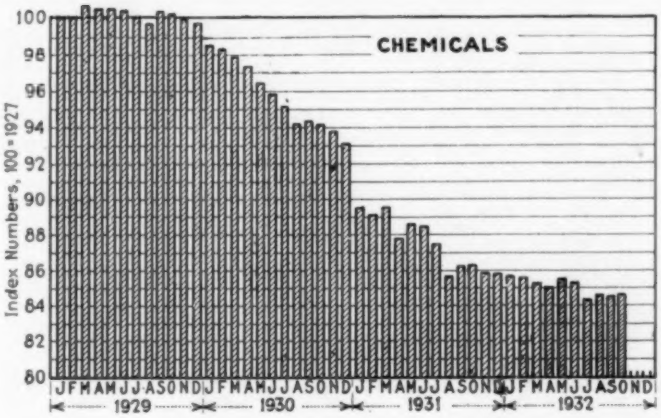
Reports from Washington say that a number of protests against dumping of foreign goods is being received by the Treasury Department. Many of these confuse depreciated currency sales with price cutting. Others fail to disclose actual damage being done to domestic producers by the advent upon the American market of foreign merchandise. Few complaints, it would appear, are valid in the face of actual conditions existing in industry.

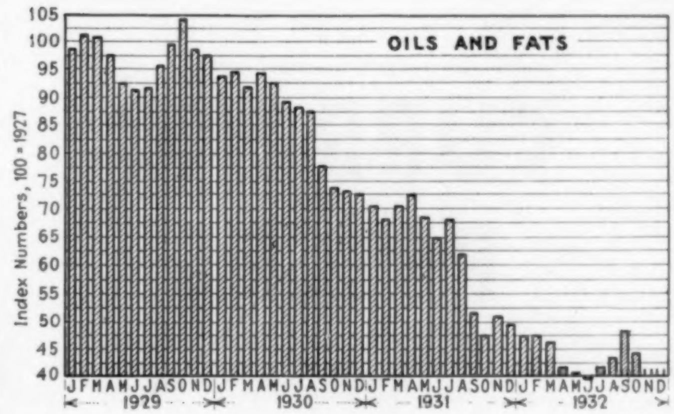
An investigation of the foreign and domestic costs of producing bronze powders and aluminum is asked of the United States Tariff Commission by the Leo Uhlfelder Company, New York, seeking a decreased rate of duty. Since 1922 the rates have been 14 cents per lb. on bronze powder and 12 cents per lb. on aluminum powder.

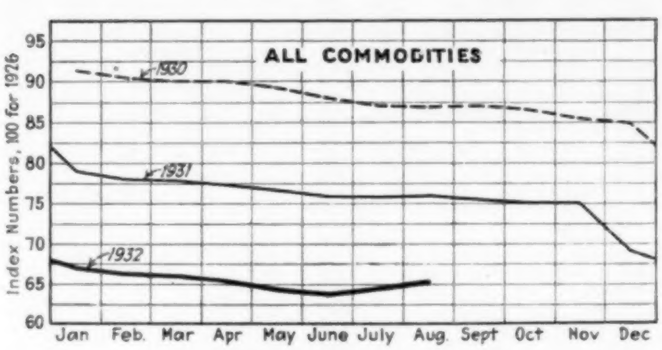
New Sulphur Production

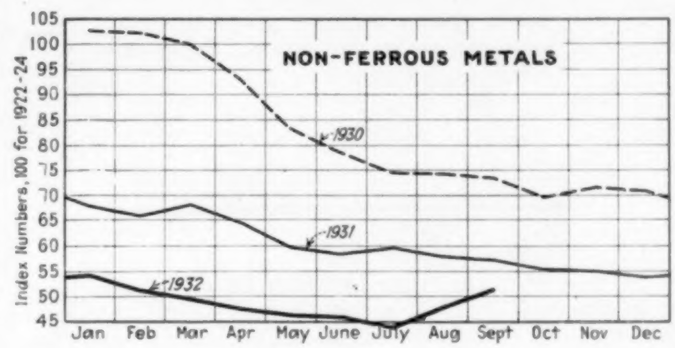
The Jefferson Lake Oil Company has completed plans to begin the production of sulphur on October 15. This will be the third important sulphur producing company in the United States, and the first in Louisiana, the other two, the Freeport Texas Company, and the Texas Gulf Sulphur Company, being across the line in Texas.

The Frasch process of super-heated water will be used in the newly completed plant. The plant is said to be gaged to a capacity of 250,000 tons annually.









PRICE TRENDS—CHEM. & MET.'S WEIGHTED INDEXES

PRICE declines were more numerous in the market for chemicals last than were advances but because of the greater weighted importance of those which were marked up, the index number for the period registered a slight advance. The most important consideration now given to prices is concerned with the figures which will prevail for contracts for 1933 delivery. The reduction in contract prices on chlorine resulted from competitive selling. While there seems to be no logical reason for a lowering in prices for heavy chemicals there is no guarantee that competition will not be keen enough to weaken values although such an outcome is not anticipated.

The metal market continues to pursue an erratic course and the metal salts are unsettled accordingly. Trade authorities disregard recent fluctuations in lead and regard the market as fundamentally sound with an upward price trend inevitable.

The failure of basic commodities, such as grains and cotton to maintain earlier advances has had an effect on the price trend in general and has even gone so far as to temper the buying movement which arose when commodity prices began to advance. This close connection between buying interest and price movements will probably be the most important factor over the remainder of the year in directing the level of prices. Given a fairly active demand, prices assume a rising tendency with a reverse action when buyers remain out of the market.

An analysis of price trends, therefore, resolves itself largely into an analysis of prospective buying power. Such industries as automotive, rubber, anti-freeze, textile, and certain divisions of the chemical trade apparently will increase requirements for the immediate future and buying interest should be sufficient at least to hold values up to their present levels.

Offerings of foreign sulphate of ammonia have been less free and the asking price has been elevated. The revised schedule for nitrate of soda also contains a price advance and speculation has arisen regarding the possibility of bringing about higher prices for nitrogen products in the world's markets.

Animal fats held up well during the month but vegetable oils lost part of the ground gained in the preceding month. Cottonseed oil followed the lead of the staple and sold at reduced levels. Other vegetable oils were influenced by the course of cottonseed oil. Linseed oil varied but little in position but the seed situation became less favorable as a result of heavy damage to the Argentine crop by locusts. As a result the Argentine exportable for next year will be smaller than it has been in a number of years. Later on this will be felt in European and American crushing centers and unless consuming demand falls sufficiently to offset this loss in supply the prospect is decidedly in favor of higher prices in the first quarter of next year if not before then.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**84.63**
Last month	84.56
October, 1931	86.37
October, 1930	94.13

Price fluctuations were reported during the month for lead oxides and for turpentine. Chlorine held at previously quoted reductions, but foreign sulphate of ammonia was firmer and a slight gain was recorded in the weighted index number. Contract prices for 1933 delivery have not yet been announced in the majority of cases.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**44.51**
Last month	48.57
October, 1931	47.40
October, 1930	73.84

Declines in price were fairly general in animal fats. Crude cottonseed oil also failed to hold the levels reached a month ago. Other vegetable oils did not show much change in position but the weighted index number was sharply lowered.

CURRENT PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Oct. 15.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	\$0.10 -\$0.11	\$0.10 -\$0.11	\$0.10 -\$0.11
Acid, acetic, 28%, bbl., cwt.	2.65 - 2.90	2.65 - 2.90	2.60 - 2.85
Glacial 99%, tanks	8.89	8.89 -	8.98 -
drs.	9.14 - 9.39	9.14 - 9.39	9.23 - 9.48
U. S. P. reagent, c'bys	9.64 - 9.89	9.64 - 9.89	9.73 - 9.98
Boric, bbl., lb.	.04¾- .05	.04¾- .05	.06¾- .07
Citric, kegs, lb.	.29 - .31	.29 - .31	.35 - .36
Formic, bbl., lb.	.10 - .11	.10 - .11	.10 - .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb., lb.	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.11½- .12
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18° tanks. cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb.	.05 - .05¼	.05 - .05¼	.05 - .05¼
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.50 -20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11 - .11½	.11 - .12
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton.	15.50 -	15.50 -	15.50 -
Tannic, tech., bbl., lb.	.23 - .35	.23 - .35	.23 - .35
Tartaric, powd., bbl., lb.	.22 - .22½	.22½- .23	.26½- .27½
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.40 - 1.50
Alcohol, ethyl, 190 p'f., bbl., gal.	2.53½-	2.53½-	2.33 -
Alcohol, Butyl, tanks, lb.	.113 -	.113-	.15¾-
Alcohol, Amyl	-	-	-
From Pentane, tanks, lb.	.182-	.182-	.203
Denatured, 190 proof			
No. 1 special dr., gal.	.34½-	.34½-	.28 -
No. 5, 188 proof, dr., gal.	.38½-	.38½-	.28 -
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03 - .04	.03¼- .04
Chrome, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Potash, lump, bbl., lb.	.03 - .04	.03 - .04	.03¼- .04
Aluminum sulphate, com., bags, cwt.	1.25 - 1.40	1.25 - 1.40	1.25 - 1.40
Iron free, bg., cwt.	1.90 - 2.00	1.90 - 2.00	1.90 - 2.00
Aqua ammonia, 26°, drums lb.	.02¾- .0[illegible]	.02¾- .03	.02¾- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb.	.15½- .15½	.15½- .15½	.15½- .15½
tanks, lb.	.05¾-	.05¾-	.05¾-
Ammonium carbonate, powd. tech., casks, lb.	.10 - .11	.10 - .11	.10½- .11
Sulphate, wks., cwt.	1.025-	1.00 -	1.30 -
Amylacetate tech., tanks, lb., gal.	.16 -	.16 -	.16½
Antimony Oxide, bbl., lb.	.07 - .08	.07 - .08	.08 - .09
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs, lb.	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	56.50 -58.00
Chloride, bbl., ton	63.00 -65.00	63.00 -65.00	63.00 -65.00
Nitrate, cask, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03¾- .04
Bleaching powder, f.o.b., wks., drums, cwt.	1.75 - 2.00	1.75 - 2.00	2.00 - 2.10
Borax, grain, bags, ton	40.00 -45.00	40.00 -45.00	50.00 -57.00
Bromine, cs., lb.	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	2.50 -	2.50 -	2.00 -
Arsenate, dr., lb.	.05½- .06½	.05½- .06½	.06 - .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	18.00 -	18.00 -	20.00 -
flake, dr., wks., ton.	21.00 -	21.00 -	22.75 -
Phosphate, bbl., lb	.08 - .08½	.08 - .08½	.08 - .08½
Carbon bisulphide, drums, lb.	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06¼- .07	.06½- .07	.06¾- .07
Chlorine, liquid, tanks, wks., lb.	.0155 -	.01¾-	.01¾-
Cylinders	.04 - .06	.04 - .06	.04 - .06
Cobalt oxide, cans, lb.	1.25 - 1.35	1.25 - 1.35	1.35 - 1.45

	Current Price	Last Month	Last Year
Copperas, bgs., f.o.b. wks., ton.	13.00 -14.00	13.00 -14.00	13.00 -14.00
Copper carbonate, bbl., lb.	.07 - .16	.07 - .16	.08½- .18
Cyanide, tech., bbl., lb.	.39 - .44	.39 - .44	.41 - .46
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	3.40 - 3.60
Cream of tartar, bbl., lb.	.17 - .17½	.17 - .17½	.21½- .22
Diethylene glycol, dr., lb.	.14 - .16	.14 - .16	.14 - .16
Epsom salt, dom., tech., bbl., cwt.	1.70 - 2.00	1.70 - 2.00	1.70 - 2.00
Imp., tech., bags, cwt.	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb.	.10 -	.10 -	.06½-
Formaldehyde, 40%, bbl., lb.	.06 - .07	.06 - .07	.06 - .07
Furfural, dr., contract, lb.	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, crude, drums, gal.	1.10 - 1.20	1.10 - 1.20	1.10 - 1.20
Refined, dr., gal.	1.80 - 1.90	1.80 - 1.90	1.80 - 1.90
Glaubers salt, bags, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Glycerine, c.p., drums, extra, lb.	.10¼- .10½	.10¼- .10½	.11½- .12
Lead:			
White, basic carbonate, dry casks, lb.	.06½-	.06½-	.07¼-
White, basic sulphate, sck., lb.	.06 -	.06 -	.07 -
Red, dry, sck., lb.	.06¾-	.07 -	.07¼-
Lead acetate, white crys., bbl.. lb.	.10 - .11	.10 - .11	.10 - .11
Lead arsenate, powd., bbl., lb.	.09½- .14	.09½- .14	.10 - .14
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb.	.05¾-	.06 -	.06½-
Lithophone, bags, lb.	.04½- .05	.04½- .05	.04½ .05
Magnesium carb., tech., bags, lb.	.05¾- .06	.05¾- .06	.06 - .06½
Methanol, 95%, tanks, gal.	.33 -	.33 -	.33 -
97%, tanks, gal.	.34 -	.34 -	.34 -
Synthetic, tanks, gal.	.35½-	.35½-	.35½-
Nickel salt, double, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Orange mineral, csk., lb.	.09¾-	.09¾-	.09¾-
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.42 - .44
Yellow, cases, lb.	.28 - .32	.28 - .32	.31 - .32
Potassium bichromate, casks, lb.	.08 - .08½	.08 - .08½	.09 - .09¾
Carbonate, 80-85%, calc. csk., lb	.05 - .05½	.05 - .05½	.05½- .06
Chlorate, powd., lb.	.08 - .08½	.08 - .08½	.08 - .08½
Hydroxide (c'stic potash) dr., lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Muriate, 80% bgs., ton.	37.15 -	37.15 -	37.15 -
Nitrate, bbl., lb.	.05½- .06	.05¾- .06	.05½- .06
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.16 - .16½
Prussiate, yellow, casks, lb.	.18½- .19½	.18½- .19	.18½- .19
Sal ammoniac, white, casks, lb.	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton.	13.00 -15.00	13.00 -15.00	16.00 -18.00
Soda ash, light, 58%, bags, contract, cwt.	1.15 -	1.15 -	1.15 -
Dense, bags, cwt.	1.17½-	1.17½-	1.17½-
Soda, caustic, 76%, solid, drums, contract, cwt.	2.50 - 2.75	2.50 - 2.75	2.50 - 2.75
Acetate, works, bbl., lb.	.05 - .06	.05 - .06	.05 - .05½
Bicarbonate, bbl., cwt.	1.85 - 2.00	1.85 - 2.00	1.85 - 2.00
Bichromate, casks, lb.	.05 - .06	.05 - .06	.07 - .07½
Bisulphate, bulk, ton.	14.00 -16.00	14.00 -16.00	14.00 -16.00
Bisulphite, bbl., lb.	.03¾- .04	.03¾- .04	.03½- .04
Chlorate, kegs, lb.	.05¾- .07½	.05¾- .07½	.05¾- .07½
Chloride, tech., ton.	12.00 -14.75	12.00 -14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.15½- .16	.15½- .16	.16½- .17
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Nitrate, bags, cwt.	1.245-	1.22 -	1.77 -
Nitrite, casks, lb	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	2.55 - 2.75	2.55 - 2.75	.0265 - .03
Prussiate, yel. drums, lb.	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.60 - .70	.60 - .70
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, cyrs., bbl., lb.	.03 - .03½	.03 - .03¾	.03 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.03½- .04	.03½- .04	.05 - .06
Dioxide, cyl., lb.	.06½- .07	.06½- .07	.06½- .07
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom.-	nom.-	nom.-
Oxide, bbl., lb.	.27 -	.28 -	27½
Crystals, bbl., lb.	.24½-	.25 -	.24 -
Zinc chloride, gran., bbl., lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Carbonate, bbl., lb.	.10½- .11	.10½- .11	.10½- .11
Cyanide, dr., lb.	.38 - .42	.41 - .42	.41 - .42
Dust, bbl., lb.	.04½- .06	.04½- .05	.05½- .06
Zinc oxide, lead free, bag, lb.	.05¾-	.05¾-	.06¾-
5% lead sulphate, bags, lb.	.05½-	.05½-	.06½-
Sulphate, bbl., cwt.	3.00 - 3.25	3.00 - 3.25	3.00 - 3.25

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	\$0.09½-\$0.10½	\$0.09½-\$0.10	\$0.10½-\$0.11
Chinawood oil, bbl., lb.	.06 -	.06 -	.07½-
Coconut oil, Ceylon, tanks, N. Y. lb.	.03¼-	.03¼-	.03¼-
Corn oil crude, tanks, (f.o.b. mill), lb	.04¼-	.04¾-	.05¼-
Cottonseed oil, crude (f o.b. mill), tanks, lb.	.03¼-	.04 -	.03½-
Linseed oil, raw car lots, bbl., lb.	.061-	.061-	.072-
Palm, Lagos, casks, lb.	.04 -	.04 -	.04
Niger, casks, lb.	.03½-	.03½-	.03¾
Palm Kernel, bbl., lb.	.04½-	.04½-	.05 -
Peanut oil, crude, tanks (mill), lb.	.06¾-	.06¾-	.05 -
Rapeseed oil, refined, bbl., gal.	.36 - .37	.36 - .37	.42 - .44
Soya bean, tank (f.o.b. Coast), lb.	nom.-	nom.-	nom.-
Sulphur (olive foots), bbl., lb.	.04½-	.04¾-	.04¾-
Cod, Newfoundland, bbl., gal.	.21 - .26	.25 - .26	.35 - .36
Menhaden, light pressed, bbl., gal.	.29 - .30	.29 - .30	.33 - .34
Crude, tanks (f.o.b. factory), gal.	.12 -	.12 -	.15½-
Grease, yellow, loose, lb.	.02¾-	.03½-	.02 -
Oleo stearine, lb.	.06 -	.06¾-	.06¾-
Red oil, distilled, d.p. bbl., lb.	.06¼-	.06¾-	.07¾-
Tallow, extra, loose, lb.	.03½-	.03¾-	.02¾-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb..	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.80 - .85
Alpha-naphthylamine, bbl., lb..	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb	.14½- .15	.14½- .15	.15 - .16
Aniline salts, bbl., lb	.24 - .25	.24 - .25	.24 - .52
Benzaldehyde, U.S.P., dr., lb	$1.10 -$1.25	$1.10 -$1.25	$1.10 -$1.25
Benzidine base, bbl., lb	.65 - .67	.65 - .67	.65 - .67
Benzoic acid, U.S.P., kgs, lb	.48 - .52	.48 - .52	.57 - .60
Benzyl chloride, tech., dr., lb	.30 - .35	.30 - .35	.30 - .35
Benzol, 90%, tanks, works, gal..	.20 - .21	.20 - .21	.20 - .21
Beta-naphthol, tech., drums, lb..	.22 - .24	.22 - .24	.22 - .24
Cresol, U. S. P., dr., lb	.10½- .11	.10½- .11	.14 - .17
Cresylic acid, 97%, dr., wks., gal.	.49 - .52	.49 - .52	.54 - .58
Diethylaniline, dr., lb	.55 - .58	.55 - .58	.55 - .58
Dinitrophenol, bbl., lb	.29 - .30	.29 - .30	.29 - .30
Dinitrotoluen, bbl. lb	.16 - .17	.16 - .17	.16 - .17
Dip oil 25% dr., gal	.23 - .25	.23 - .25	.26 - .28
Diphenylamine, bbl., lb	.38 - .40	.38 - .40	.38 - .40
H-acid, bbl., lb	.65 - .70	.65 - .70	.65 - .70
Naphthalene, flake, bbl., lb	.04½- .05	.03¾- .04½	.03¾- .04½
Nitrobenzene, dr., lb	.08½- .09	.08½- .09	.08½- .10
Para-nitraniline, bbl., lb	.51 - .55	.51 - .55	.51 - .55
Para-nitrotoluine, bbl., lb	.26 - .28	.26 - .28	.29 - .31
Phenol, U.S.P., drums, lb	.14½- .15	.14½- .15	.14½- .15
Picric acid, bbl., lb	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb	1.50 - 1.75	1.50 - 1.80	1.50 - 1.80
R-salt, bbl., lb	.40 - .44	.40 - .44	.40 - .44
Resorcinal, tech., kegs, lb	.65 - .70	.65 - .70	1.15 - 1.25
Salicylic acid, tech., bbl., lb	.33 - .35	.33 - .35	.33 - .35
Solvent naphtha, w.w., tanks, gal.	.26 -......	.26 -......	.25 - .30
Xolidine, bbl., lb	.86 - .88	.86 - .88	.86 - .88
Toluene, tanks, works, gal	.30 -......	.30 -......	.30 -......
Tylene, com., tanks, gal	.26 -......	.26 -......	.25 - .28

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00-$25.00	$22.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb	.06 - .10½	.06 - .10½	.06 - .11
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb	.02¾- .20	.02¾- .20	.03 - .20
Prussian blue, bbl., lb	.35 - .36	.35 - .36	.35 - .36
Ultramine blue, bbl., lb	.06 - .32	.06 - .32	.06 - .32
Chrome green, bbl., lb	.26 - .27	.26 - .27	.27 - .30
Carmine red, tins, lb	3.90 - 4.50	3.90 - 4.50	5.00 - 5.40
Para toner, lb	.75 - .80	.75 - .80	.77 - .80
Vermilion, English, bbl., lb	1.25 - 1.50	1.25 - 1.50	1.55 - 1.60
Chrome yellow, C. P., bbl., lb.	.16 - .16½	.16 - .16½	.16½- .17
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 - .08½	.07 - .08½	.07 - .08½
Gum copal Congo, bags, lb	.06 - .08	.06 - .08	.07 - .09
Manila, bags, lb	.16 - .17	.16 - .17	.16 - .17
Damar, Batavia, cases, lb	.16 - .16½	.16 - .19	.16 - .16½
Kauri No. 1 cases, lb	.45 - .48	.45 - .48	.48 - .53
Kieselguhr (f.o.b. N.Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	40.00 -......	40.00 -......	40.00 -......
Pumice stone, lump, bbl., lb	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb	.03 - .40	.03 - .40	.03 - .35
Rosin, H., bbl	4.05 -......	4.30 -......	4.05 -......
Turpentine, gal	.45½-......	.46 -......	.36 -......
Shellac, orange, fine, bags, lb	.20 - .25	.20 - .25	.38 - .40
Bleached, bonedry, bags, lb	.18 - .19	.18 - .19	.28 - .30
T. N. bags, lb	.10½- .11½	.10½- .11	.16 - 17
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12 00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 - 8.50	8.00 - 8.50	9.50 -.....
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -....	13.75 -.....	13.75 -.....
Wax, Bayberry, bbl., lb	.16 - .20	.16 - .20	.19½- .22
Beeswax, ref., light, lb	.20 - .30	.20 - .30	.25 - .27
Candelilla, bags, lb	.12 -......	.11 -......	.13 - .14
Carnuba, No. 1, bags, lb	.26 -......	.21½-......	.33 -......
Paraffine, crude 105-110 m.p., lb	.03½- .03¾	.03½- .04½	.03½- .03¾

Price Changes During Month

Advanced	Declined
Ammonium sulphate	Red lead
Nitrate of soda	Litharge
Naphthalene	Orange mineral
	Tin crystals
	Tin oxide
	Cottonseed oil
	Tallow

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200.00-.....	$200.00-.....	$200.00-.....
Ferromanganese, 78-82%, ton	68.00-.....	68.00-.....	80.00-85.00
Ferrochrome, 65-70%	.10-.....	.10-.....	.11-.....
Spiegeleisen, 19-21% ton	25.00-.....	25.00-.....	30.00-.....
Ferrosilicon, 14-17%, ton	31.00-.....	31.00-.....	39.00-.....
Ferrotungsten, 70-80%, lb.	1.00- 1.10	1.00- 1.10	1.00- 1.10
Ferrovanadium, 30-40%, lb.	3.05- 3.40	3.05- 3.40	3.15- 3.50

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb	$0.06¼-......	$0.06¼-......	$0.07 -......
Aluminum, 96-99%, lb	.229-......	.229-......	.233-......
Antimony, Chin. and Jap., lb	.05½-......	.055-......	.065-......
Nickel, 99%, lb	.35 -......	.35 -......	.35 -......
Monel metal blocks, lb	.28 -......	.28 -......	.28 -......
Tin, 5-ton lots, Straits, lb	.243-......	.253-......	.22¼-......
Lead, New York, spot, lb	.0345-......	.036-......	.04 -......
Zinc, New York, spot, lb	.034-......	.0382-......	.035-......
Silver, commercial, oz	.28¼-......	.28¼-......	.28 -......
Cadmium, lb	.55 -......	.55 -......	.55 -......
Bismuth, ton lots, lb	.85 -......	.85 -......	1.50 -......
Cobalt, lb	2.50 -......	2.50 -......	2.50 -......
Magnesium, ingots, 99%, lb	.30 -......	.30 -......	.48 -......
Platinum, ref., oz	33.00 -......	35.00 -......	40.00 -......
Palladium, ref., oz	18.00 - 19.00	18.00 - 19.00	19.00 - 21.00
Mercury, flask, 75 lb	47.00 - 48.00	47.00 - 48.00	74.00 - 75.00
Tungsten powder, lb	1.45 -......	1.45 -......	1.45 -......

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$6.50 -$8.25	$6.50 -$8.25	$6.50 -$8.25
Chrome ore, c. f., post, ton	16.50 -19.00	16.50 -19.00	19.50 -24.00
Coke, fdry., f.o.b. ovens, ton	3.25 - 3.75	3.25 - 3.75	3.25 - 3.75
Fluorspar, gravel, f.o.b. Ill., ton	17.25 -20.00	17.25 -20.00	17.25 -20.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.23 -......	.23 - ...	.25 - .27
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb	.45 -......	.45 -......	.35 - .40
Monazite, 6% of ThO_2, ton	60.00 -......	60.00 -......	60.00 -......
Pyrites, Span. fines, c.i.f., unit	.13 -......	.13 -......	.13 -......
Rutile, 94-96% TiO_2, lb	.10 - .11	.10 - .11	.10 - .11
Tungsten, scheelite, 60% WO_3 and over, unit	9.00 -10.50	9.00 -10.50	11.25 -12.00

INDUSTRIAL NOTES

WORTHINGTON PUMP AND MACHINERY CORP. with plants at Buffalo, N. Y., Harrison, N. J., and Holyoke, Mass., through its Meter Division, has entered into an arrangement with the Gamon Meter Co., Newark, N. J., for the production of meters through the joint use of the manufacturing, engineering, sales and service facilities of the two companies.

JEFFREY MANUFACTURING CO., Columbus, Ohio, has removed its southwestern branch office from Houston to Dallas, Texas. T. P. Burke continues as manager.

U. S. INDUSTRIAL ALCOHOL CO., New York, has introduced a double-head drum which permits automatic shipping of dealer advertising matter with the drum itself. Inside surface of the detachable head becomes an outdoor lithographed metal sign.

INGERSOLL STEEL AND DISC CO. of Chicago has patented a two-ply stainless steel and entered into a license agreement with the Allegheny Steel Co., Brackenridge, Pa., by which the latter will manufacture two-ply stainless steel sheets exclusively under the patents of the Ingersoll company.

NEW ENGLAND TANK & TOWER CO., Everett, Mass., has completed plans for an addition to its plant. The addition will occupy 7,300 sq.ft. and will house the offices of the company and equipment for manufacturing tanks.

KESSLER CHEMICAL CORP. subsidiary of the American Commercial Alcohol Corp. has transferred its plant from Orange, N. J., to Philadelphia.

ALCO PRODUCTS, INC., DIVISION OF AMERICAN LOCOMOTIVE CO. has entered into agreement with Gyro Process Co. of Detroit, whereby Alco has acquired exclusive licensing, sales, engineering and manufacturing rights for the Gyro vapor phase cracking process for production of anti-knock gasoline.

MARLIN-ROCKWELL CORPORATION, Jamestown, N. Y., has consolidated at Jamestown, sales activities formerly carried on independently by its subsidiaries, Gurney Ball Bearing Division, Jamestown; Standard Steel and Bearings Inc., Plainville, Conn.; and Strom Bearings Co., Chicago.

FOOTE BROTHERS GEAR AND MACHINE COMPANY, Chicago, announce the appointment of J. L. Kilroy, Chicago, Louisville, Ky., as representative in Kentucky and all cities on the Ohio River in Indiana and Ohio, with the exception of Newport and Ashland.

NEW CONSTRUCTION

Where Plants Are Being Built in Process Industries

	This Month		Year to Date	
	Proposed Work and Bids	Contracts Awarded	Proposed Work and Bids	Contracts Awarded
New England	$205,000	$40,000	$1,655,000	$337,000
Middle Atlantic	330,000	159,000	3,120,000	5,330,000
Southern	790,000	....	2,185,000	549,000
Middle West	40,000	130,000	1,723,000	2,193,000
West of Mississippi	780,000	165,000	19,307,000	1,520,000
Far West	1,825,000	40,000	4,140,000	931,000
Canada	200,000	30,000	9,895,000	7,685,000
Total	$4,170,000	$564,000	$42,025,000	$18,545,000

PROPOSED WORK BIDS ASKED

Baking Compound Factory—Lookout Oil & Refining Co., R. E. Biggers, Gen. Mgr., Kirkland Ave., Chattanooga, Tenn., a subsidiary of Armour & Co., Chicago, Ill., plans to build a factory for the manufacture of "cre-mit" a baking compound. Estimated cost $250,000.

Brick and Clay Products Factory—Owner, c/o J. W. Warren, Archt., 72 James St. N., Hamilton, Ont., plans to construct a 1 story factory to manufacture fire brick and other clay products, north of Kapuskasing, Ont. Estimated cost $50,000.

Dry Ice Plant—Pacific Carbonic Co., T. F. Pattinson, Mgr., R. F. D. No. 2, Box 143, Orange, Calif., has leased site on Terminal Island, San Pedro, and plans the construction of a dry ice manufacturing plant. Estimated cost $200,000.

Gas Plant—Southern Engineering & Management Corp., Jacksonville, Fla., plans to construct gas plants and distribution systems in Melbourne, Eau Gallie and other locations in Florida. Estimated cost $40,000.

Gas Plant—City Gas & Electric Dept., J. J. Kirkpatrick, Mgr., Holyoke, Mass., had plans prepared for gas plant. Bids will be taken next year. Estimated cost $175,000.

Gas Plant—New York Central Electric Co., 89 East Ave., Rochester, N. Y., plans the construction of a gas plant and distribution system at Savona (Steuben Co.), N. Y. Estimated cost to exceed $40,000.

Gas Plant—Elmira Light, Heat & Power Co., Elmira, N. Y., plans the construction of a gas plant and distribution system at Southport (Chemung Co.), N. Y.

Gasoline Plant—Indian Territory Illuminating Oil Co., Bartlesville, Okla., plans the construction of a casing-head gasoline plant. Estimated cost $30,000.

Ink Plant—International Printing Ink Co., 75 Varick St., New York, N. Y., has leased building at 240 Richmond St., East, Toronto, Ont., and will alter same and install equipment for the manufacture of ink. Estimated cost $100,000. R. E. Talton, 240 Richmond St., is manager.

Kiln Plant—Kelly Island Lime & Transport Co., Clay Center, O., awarded contract for steel in connection with new plant here to Burger Iron Co., Akron, O. Cost of plant to exceed $40,000.

Laboratory—White Memorial Hospital, 304 North Boyle Ave., Los Angeles, Calif., awarded contract for 3 story, 40 x 80 ft. laboratory to C. I. Swinhart, 1642 Garth St., Los Angeles.

Paper Plant—Canada Paper Co., Ltd., St. Andrews East, Quebec, plans to construct a factory for the manufacture of absorbent waddings, facial tissues, etc.

Paper Plant—Newton Falls Paper Co., Newton Falls, N. Y., and 330 West 42nd St., New York, N. Y., T. C. Hanna, in charge, will construct an addition to its plant. Work will be done by day labor and separate contracts. Estimated cost, including equipment, $35,000.

Paper Mill—Bogalusa Paper Co., Inc., M. E. Cody, Gen. Mgr., Bogalusa, La., is having surveys made by United Engineers & Constructors, Inc., Cons. Engrs., 112 North Broad St., Philadelphia, Pa., for enlarging and improving paper mill here, to include bleaching plant, new additions to No. 1 and 2 paper machines, wood room equipment, sulphate recovery system, boilers, generators, pump washers, pulp screens, lime burners, etc. Estimated cost $500,000.

Raybestos Factory — Raybestos-Manhattan, Inc., 1427 Rilroad Ave., Bridgeport, Conn. is receiving bids for a brick factory addition and office at their plant at Stratford. Estimated cost $30,000.

Refinery—C. F. Dickey, Wichita, Kan., plans the construction of an oil refinery at McPherson. Estimated cost $100,000.

Refinery—Syndicate, c/o Bradford Transit Co., Olean and Bolivar, N. Y., is having preliminary plans prepared for the construction of an oil refining plant at Bolivar. Estimated cost $40,000.

Refinery—East Texas Refining Co., Longview, Tex., is having preliminary surveys made for the construction of a gasoline and oil refinery plant. Estimated cost $600,000.

Refinery—General Petroleum Corp., Torrance, Calif., and c/o Socony-Vacuum Corp., 26 Bway., New York, N. Y., plans to construct petroleum refinery here, also extend pipe line facilities. Est mated cost $1,500,000.

Refinery—Gladwater Refining Co., Gladwater, Tex., plans the construction of a refinery. Estimated cost $50,000.

Refinery—Kendall Refining Co., Bradford, Pa., plans the construction of a vacuum distillation unit for special motor oil production at its refinery here. Estimated cost $30,000.

Refinery—Marwell Gas & Oil Co., Rochester, N. Y., plans to rebuild refinery and oil storage plant recently damaged by fire. Estimated cost $100,000.

Refinery—Union Oil Co. of California, Union Oil Bldg., Los Angeles, Calif., plans to alter refinery at Wilmington, Calif., to include pressure distillate stabilizer. Estimated cost $125,000.

Rubber and Tire Manufacturing Plant—Spanish Firestone Co., Madrid, Spain, and Firestone Rubber Co., 1278 South Main St., Akron, Ohio, plans the construction of a rubber and tire manufacturing plant in Spain. Estimated cost $500,000.

Soap Factory—Brown Tick, 132 Gifford Ave., Jersey City, N. J., plans to rebuild 2 story factory at 142 Logan Avenue recently destroyed by fire. Building will be leased to Atlan Soap Works, Inc., 142 Logan Ave., Jersey City. Estimated cost $40,000.

Tallow Rendering Plant—Louis Stern's Sons, Inc., 4th St. and Hackensack River, Kearny, N. J., is having preliminary plans prepared for 1 story tallow rendering plant. Estimated cost $40,000. Otto S. Sehlich, 136 Liberty St., New York, N. Y., is architect and engineer.

Sugar Refinery—Union Socialist Soviet Republics, c/o Amtorg Trading Co., 261 5th Ave., New York, N. Y., plans to construct a sugar refinery in the Rubtovsky District, West Siberia. Estimated cost to exceed $1,000,000.

Factory — H. Schindler & Co., Inc., 121 Lamartine St., Boston, Mass., plans the construction of a factory at Mimico, Ont., for the manufacture of silk and gut strings for tennis and badminton racquets and musical instruments.

CONTRACTS AWARDED

Chemical Plant — Mitsüi Mining Co., c/o Mitsüi & Co., Ltd., 350 5th Ave., New York, N. Y., awarded technical aid contract for chemical plant at Müke (Kuishui Province), Japan, to E. I. duPont de Nemours Co., Wilmington, Del. Estimated cost $1,500,000.

Chemical Plant—Standard Bauxite & Chemical Co., Frank Finsthwit in charge, Benton, Ark., will construct a plant here. Estimated cost $30,000. Work will be done by separate contracts.

Experimental Laboratory—Grasselli Chemical Co., Guardian Bldg., Cleveland, O., awarded contract for 3 story, 50 x 60 ft. experimental laboratory, to Hunkin-Conkey Constr. Co., Newman-Stern Bldg., Cleveland. Estimated cost $40,000.

Gas Plant — Empire Gas & Fuel Co., Ltd., Wellsville, N. Y., plans the construction of a gas plant and distribution system at Almond Village and Allegheny and Steuben Co., N. Y. Work will be done by day labor and separate contracts.

Laboratory—John B. Pierce Foundation, M. G. Ullman, Yonkers, N. Y., awarded contract for 2 story, 45 x 58 ft. hygienic laboratory at Liberty and Congress Sts., New Haven, Conn., to National Construction Co., 152 Temple St., New Haven. Estimated cost $40,000.

Paint Factory—Sewall Paint & Varnish Co., E. Ross Kyger, Treas., 1009 West 8th St., Kansas City, Mo., awarded contract for 1 story, 23 x 59 ft. paint factory on West 8th St., to Swenson Constr. Co., Shubert Theatre Bldg., Kansas City.

Paper Factory—DePere Paper & Manufacturing Co., c/o Herman Miller, 415 South Van Buren St., Green Bay, Wis., awarded contract for 1 story, 50 x 60 ft. paper manufacturing plant at DePere, Wis., to Sam Clark, 326 Marsh St. W., DePere. Estimated cost $40,000.

Factory—Canadian Raybestos Co., Ltd., Peterboro, Ont., awarded contract constructing brick additions to plant, to T. A. Braun Co., Ltd., 1121 Bay St., Toronto, Ont. Estimated cost $30,000.

Porcelain Plant—E. Friedrich, East Commerce St., San Antonio, Tex., is building a porcelain plant by day labor. New equipment, including electrically operated plating machinery, etc., will be purchased.

Refinery—Continental Refining Co., Oil City, Pa., awarded contract for boiler house at refinery to Bouquin Co., Oil City, Pa. Estimated cost $30,000.

Refinery.— Donlon Refining Co., P. Miller, Pres., Cotton Exchange, Oklahoma City, Okla., had plans prepared for 2,000 bbl. oil refinery. Work will be done by day labor. Estimated cost $75,000.

Soap Plant — Muhlens & Kropff, 87 Bway., Jersey City, N. J., awarded contract for altering and building 1 story addition to plant at Bway. and Giles Sts., to James Billington, Inc., 198 Fairmont St., Jersey City, N. J. Estimated cost $28,500.

Soap Plant — Proctor & Gamble Mfg. Co., Port Ivory, S. I., N. Y., will build a 1 story, 25 x 145 ft. soap plant at 1450 Richmond Terrace, by day labor. Estimated cost $25,000.

Solvents Factory—Sharples Solvents Corp., 23rd and Westmoreland Aves., Philadelphia, Pa., awarded contract for 1 story factory for manufacture of amyl alcohol for automobile lacquer, on Pennsylvania Ave., Wyandotte, Mich., to Michigan Foundation Co., Inc., 110 West Jefferson Ave., Trenton, Mich. Estimated cost $50,000.